A Photogrammetric Survey for the Documentation of Archaeological Sites

Introduction

During the survey of an archaeological site, the documentation stage plays a fundamental role both for the comprehension of the site, its geographical position and its physical characteristics, as well as for the correct planning of further operations. Survey and documentation concern objects on different scales, but above all, with different goals: a preliminary survey of the site is important in order to draw up an approximate plan to georeference excavations, assays, tests and findings, but the survey stage must also include the single object, the detail, for which it is necessary to provide a quantitative and qualitative description.

Besides giving complete documentation, it is also necessary to record the different steps of the excavation and their chronological sequence day by day. In fact, these elements are necessary to reconstruct the site and to understand the real history of the find. Usually all these operations are carried out by traditional techniques, such as direct survey, and with simple instruments of measurement like measuring tapes and plumb lines. These instruments are easy to find, and to use, but they also require a considerable amount of time. The techniques of this kind of survey involve a great deal of interpretation on the part of the surveyor, and consequently the final result is directly related to the experience of the operator.

New technologies now make it possible to overcome all these problems by the use of different survey techniques such as topographic instruments, photogrammetry, GPS and laser scanning. These are used in different scientific fields, but they are widely tested and verified. Unfortunately, some of these techniques are difficult to use for various reasons, mainly the high cost of instruments, and the necessity of specialized technicians to survey and process the data acquired.

Photogrammetry, especially digital photogrammetry, seems to be more suitable for an archaeological site survey in consideration of the requirements which become evident during an excavation. Digital photogrammetry can be considered a suitable survey technique, useful and easy to use during complex field operations.

One of the most important reasons for a wide use of digital photogrammetry is the low cost of the survey operation. The possibility of using a non-metric digital camera, compared to the most expensive and less handy metric or semi-metric cameras, is important for the diffusion of this technique. Another important aspect of digital photogrammetry is the speed of data acquisition. Indeed, it is a well-known fact that it is very difficult to combine together the traditional operations of excavation with the documentation stage at the same time. As will be explained in the following paragraphs, this problem has been solved, because in order to document an object or a monument it is necessary only to take some pictures using a precise scheme of acquisition. The third big advantage of the photogrammetrical approach is the simplicity of use represented by the new software which permits the reconstruction of a 3D object by simply starting from some photographs (a minimum of two).

Because of their particular characteristics, the results of a photogrammetrical survey can be used in different ways and contexts. It is possible to obtain traditional bidimensional drawings, as maps and sections, but also more complex and multimedia representations which are suitable for virtual museums or on the web. They can also be simply stored like a sort of metrical database of monuments, handmade pots, etc.

The last point concerns the precision of the measurements and, in general, of the results of this kind of application. Many authors verified that the precision achieved by close range photogrammetry, using a low cost camera, is lower than that of other survey methods, like topographic surveys or laser scanners. In any case, it ensures that the levels of precision necessary for the documentation of an archaeological site are reached

Digital photogrammetry

One of the main tasks of traditional photogrammetry is the precise 3D reconstruction of an object given a (minimum) set of images. However, in the last few years, with the increasing use of digital cameras, the number of images being used has increased compared to the past, mainly due to texture mapping applications. Features like points and lines are observed in the images and 3D coordinates are determined, in a given coordinate system, under a central projection mathematical model (collinearity). Photogrammetry aims at achieving the highest possible accuracy using a certain system and image network.

The use of digital applications established a renewed interest in this technique, and in particular computer vision became an important ally of photogrammetry, not only in the management of digital images, but also in the planning of software, with new functions and applications. In particular, the main aspects concern the image based reconstruction of 3D objects and the use of surface models and textures to obtain a metrically correct 3D texturized digital model. The advantages of this technique are the merging of metrical precision with photorealism, with the possibility of modelling complex details using semi-automatic and flexible instruments.

Many softwares give similar results (Image Modeler, Shape Capture, Canoma), but in particular the following examples were made using Eos System's Photomodeler.

Stages of operation

Survey and documentation of an archaeological site, by close range photogrammetry, can be subdivided into different steps corresponding to the stages of: camera calibration, image acquisition, model orientation and data processing.

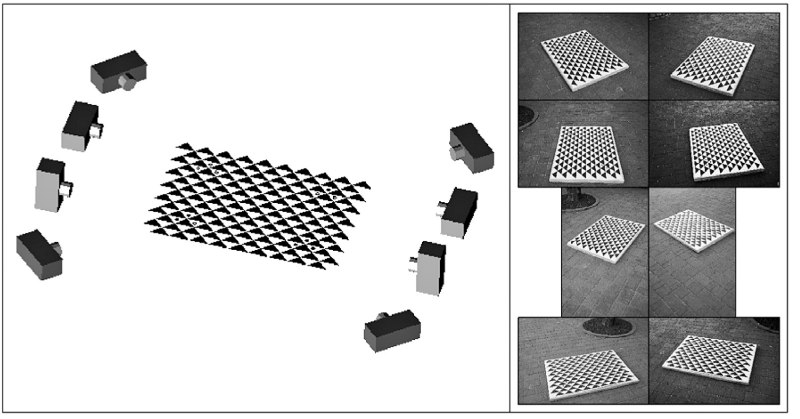

Fig. 1 – Design showing position and orientation of cameras during the photography of the calibration panel, and example of images.

In chronological order, the first stage involves calibration of the camera. This operation is necessary because, in non-metric digital cameras, the interior orientation parameters (principal distance, principal point coordinate and radial distortion) must be evaluated. It is necessary to photograph a calibration panel from different positions, as defined by the manufacturer, in order to complete the self calibration process and set the unknown parameters. This preliminary setting should be made before each image acquisition, directly in the archaeological site, and keeping the settings of the camera constant during field operations.

The software can apply a bundle adjustment analytical model for calibration by using several images of the plane test-field, supplied with the software. In this case, the process is fully automatic (since Photomodeler 5.0), requiring at least 8 images recorded in a suitable multi-station geometry, an initial estimation of the focal length and image-identifiable coded targets which form the object point array (Fig. 1).

It is important to maintain a fixed focus setting and the focal length in all images both in the calibration stage or during the documentation of excavation. For all images it is necessary to apply a scheme of convergent photos. Finally, in order to improve calibration, images should be taken from different positions and different distances to make up for the use of a simple bi-dimensional calibration panel. Upon completion of self calibration the software provides principal distance, principal point coordinate and radial distortion.

In the second stage, images should always be taken using a scheme of convergent photos. In order to document a stratigraphic section or part of a wall (essentially 2D objects) photos should be acquired from three different positions: traditionally from right, from left and from the front. For 3D objects, the acquisition scheme foresees taking images of all sides of the object, so that even the smallest detail will be visible in at least two frames (Fig. 2).

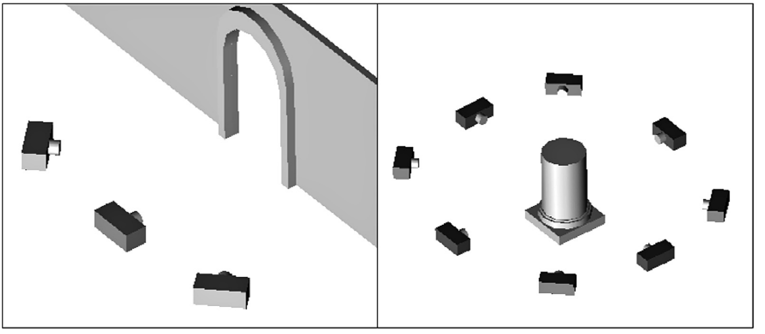

Fig. 2 – Design for monoscopic photogrammetry: 2D object (left) and 3D objects (right).

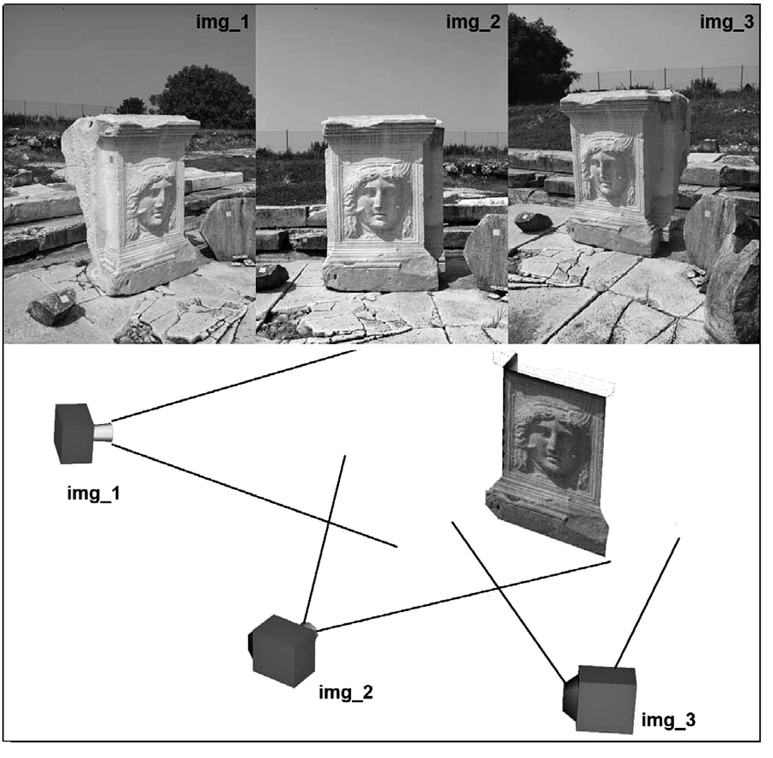

Fig. 3 – Example of the three photographs of the object and virtual representation of the original position of the camera for each photo.

Once the inner orientation is defined, it is necessary to focus on the exterior one in order to reconstruct the position of the camera for each shot. Homologous points have to be collimated in each image and then the scale of the 3D photographic model must be defined by direct measurements from the archaeological site.

This procedure can be carried out in two different ways. With the first method it is possible to use only a linear distance as a real length of a segment represented in the image to input into the software. In this way the whole model is metrically correct, but it does not have the definition of a reference system and the object cannot be located precisely.

Using the second method, it is necessary to input the real coordinates of some points or features which can be recognized in the images. For this reason surveyed points are used not only to scale the model, but also to georeference it in the same reference system of the whole site (Fig. 3).

Both these solutions have advantages which should be carefully considered. Indeed, the first – using only a distance acquired by a measuring tape – allows us to manage all the operations in a way that is both simple and fast and, above all, there is no need for technologically advanced instruments. The second option, although it requires use of a total station, is very useful because it makes it possible to put every object (test, probing or finding) in its exact position. At the end, the software gives the camera position for each shot. It shows the object in a virtual space and calculates three parameters of translation and three parameters of rotation.

In the last step, the final model of representation must be chosen. Once the 3D model is virtually reconstructed, it is possible to choose between different possibilities. The first one is to use the reconstructed model as a sort of spatial database which can give much information about metrical aspects and position. Otherwise, a vector drawing can be obtained by using points to define relevant elements in the images and then it can be exported in software CAD for the last editing operation.

These types of software make it possible to create a 3D digital model of a surveyed object by using surfaces like meshes, nurbs and also by geometrical standard solids such as cubes, cylinders and cones. It is possible to assign a radiometrical attribute to these elements; it can be a synthetic material or colour, or a texture from the images, in such a way as to wrap the model to obtain a realistic 3D representation of the surveyed object. This final product is suitable for many different applications such as databases, archives, etc. But it can be used also in museums to show a virtual copy of famous objects. The file format VRML, for example, contains both geometry and textures and is suitable for the displacement of a 3D model in every information context.

Applications

All these examples concern archaeological sites, located in different parts of Italy, but above all they represent many of the possibilities and real cases which are very common in an archaeological excavation.

The first example involves an experiment conducted at an archaeological site in Aquileia, near Gorizia. Specifically, the object to be documented was a basement found in the "Foro Est" of the old Roman town (Fig. 4). First of all, the site was surveyed with different instruments and techniques such as topographic tools, GPS and laser scanner. Then some of the details were studied using the applica-

Fig. 4 – Navigation of the model in a virtual space using a VRML player.

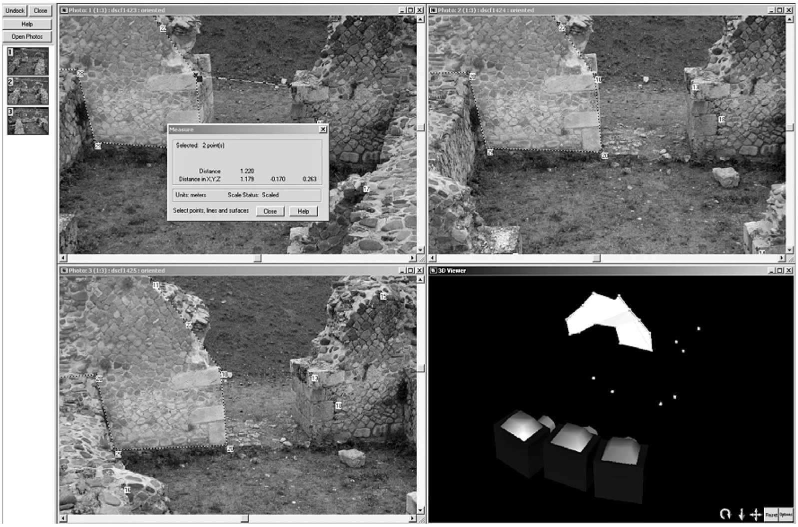

Fig. 5 – Some functions of the software: measure of distance, coordinates of the point.

tion and software described here. After the calibration of a non-metric camera by the calibration panel, some shots were taken so as to reconstruct the 3D model. The scaling operation was conducted using just a simple distance, because our attention was not focused on the whole area, but on particular artefacts. After data processing, the 3D texturized model was exported to a virtual model using a VRML file that can be simply visualized by a freeware VRML player like Cortona or Cosmo Player.

The second example concerns the survey of an amphitheatre, in the Roman town of *Grumentum* in Basilicata, near Potenza (Fig. 5). In particular, after a GPS survey to create a reference system, some of the buildings were documented using digital photogrammetry, especially Photomodeler. In this application the software was used to recognise the geometry of some specific areas of the amphitheatre. Instead of using a single distance, the model, obtained by digital images, was scaled and georeferenced in a single step using a surveyed point. By using this procedure, the texturized meshes of walls are located in their correct position inside the local reference system.

Conclusions

Due to its numerous advantages and ease of use, digital photogrammetry is increasingly used not only in the architectural field, but also in archaeology. For the future, it would be interesting to study a more detailed protocol to document excavations, considering the possibility of storing not only artefacts, monuments and recent finds, but also for recording the different steps of probing and trials.

Another point to consider is the combined use of photogrammetry with other survey techniques such as laser-scanning. This is a high cost technology and it requires technicians, but in an archaeological site the use of a laser-scanner, even for a short period of time, enables us to obtain a local placement – even for a big site – as well as the initial reconnaissance. Details of monuments and artefacts can be documented and surveyed by the photogrammetric techniques described above.

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Archaeology and the Tablet PC

Introduction

The Tablet PC[1] is a mobile computer of small dimensions with a screen that you can interact with by using an optical pen, which has digital ink that can be then converted to typed text using software such as Microsoft Word. The Tablet PC was created for use everywhere and under all conditions. Entire professional categories need documents, files, email and electronic agendas. They need to exchange information and data using portable systems as easily as they use a Personal Computer.

Before the birth of the Tablet PC, the only way to satisfy these requirements was to choose between a PDA and a simple notebook. PDAs of the last generation are small but they do not have the functions of a PC. Notebooks on the other hand are as powerful as desktops, but they cannot be defined as mobile in the true sense of the word. To solve this problem it is possible to use Tablet PCs, which are divided into two categories: slates and convertibles. Slate Tablet PCs have no lid or keyboard and they have the advantage of being particularly light and small sized. Convertible Tablet PCs are notebooks that can be transformed into a tablet by rotating and closing the screen over the keyboard.

The Tablet PC is used with an electromagnetic pen ("digital ink"), similar in shape to the optical pen of the PDA. The technology used by the most of the producers is called "Active Digitizer" and has the following particular characteristic: the layer sensor for the input is behind the LCD screen. Tablet PCs use Windows XP Tablet PC Edition that differs from the classic version of Windows XP because it is able to recognise handwriting and offers the possibility of using digital ink also for Office applications.

Tablet PC and Cultural Heritage

The use of this instrument in the cultural heritage sector is not widespread, however there are some examples where a Tablet PC has had an important role in archaeological studies. Two Italian case-studies are cited: the first one for archaeological research and the second one for didactic and tourist purposes. In both cases, the University of Siena has played a fundamental role. In the first case the

[1] See the website http://www.tabletpc.it/ dedicated to Tablet PCs. In the section FORUM, it is possible to find various links to websites with software developed for Tablet PC applications.

LAP&T Laboratory[2] of the University of Siena in Grosseto (Italy) has for many years made use of the archaeological potential of aerial photos working with Tablet PCs (Campana 2005a; 2005b). In fact, it is possible to install the same software used in the laboratory and have access to data directly on the airplane.

This solution offers the mobility necessary to produce a quick and accurate result. The possibility of connecting a Tablet PC to a GPS Bluetooth helps to localize archaeological anomalies. In fact, it is possible to record the aerial flight routes, the points and the position of all archaeological traces, vertical air photographs, satellite images, data from surveys, published literature and documentary sources, traditional and topographical maps and have them directly on the GIS installed on the Tablet PC.

Another example in which a Tablet PC has been used is called "In&Out". A Tablet PC, created by the University of Siena and the Agorà ICT Society, was transformed into a multimedia tourist guide (Benelli, Todini and Masini 2006). Using the screen of the Tablet PC it is possible to reconstruct the life and the rituals of the Etruscan people, the history and geography of archaeological sites. Given the easy use of the Tablet PC pen, notes can be taken and it is possible to listen to mp3 music and see movies. Using Bluetooth technology, it is possible to listen directly to audio information from earphones. The "In&Out" guide represents a recent example in which new technology offers opportunities for the development of tourism.

Another project, which involved the historical town of Viggiano (PZ – Italy), is still in the working phase. The Tablet PC has been used for the creation of a GIS for the purpose of conducting a census of the Viggiano cultural heritage and in particular of its historical portals (Cianciarulo 2006). Tablet PC will also be used for the creation of a multimedia guide in which to integrate historical information, audio and video.

The experiment in *Grumentum* (Grumento Nova – Basilicata – Italy): The creation of the digital photoplan and the vector drawn on Tablet PC

The experiment[3] was conducted in the archaeological site of the Roman town of *Grumentum* (Mastrocinque 2006) in the Basilicata Region – South Italy. The Tablet PC Fujitsu Siemens Stylistic ST4121 Outdoor 933 with screen TFT 10,4 inches (Fig. 1) was used in *Grumentum*. The processor is an Intel Pentium III 933 MHz. The hard disk of 60 GB has turned out to be more than sufficient for data saving operations. To enable the Tablet PC to work with numerous softwares contemporaneously, the computer RAM was increased to 768 MB. Many programs were implemented to make a digital photoplan and use CAD software.

[2] LAP&T Laboratory of Landscape Archaeology and Remote Sensing – University of Siena at Grosseto (Italy), Scientific Direction Dr Stefano Campana (http://www.lapetlab.it/).

[3] Thanks to Prof. A. Mastrocinque – University of Verona (Italy), Scientific Director of *Grumentum* Project 2005-2007.

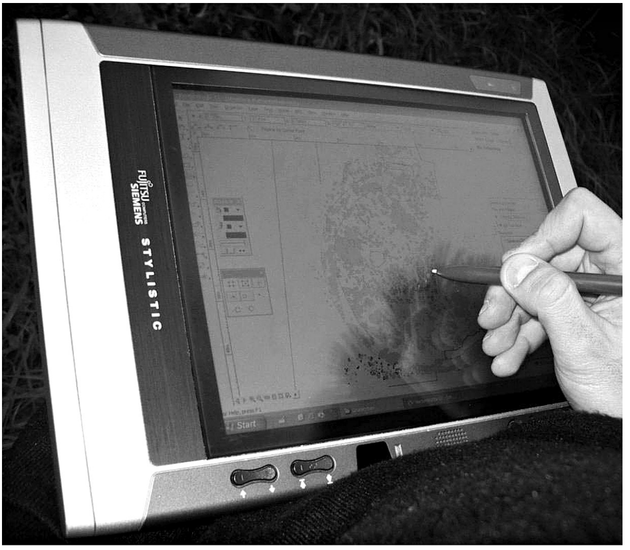

Fig. 1 – The Tablet PC used in the *Grumentum* site.

During the last excavation in August 2006, an area was excavated near the Roman *Forum* (Fig. 2) and a circular structure was brought to light (Fig. 3). This area of 12m×13m was selected to try this new methodology. After marking off the circumference of the structure, the area was divided into rectangles of 2m×1,5m. At the margins of these rectangles, targets fixed through a total station were applied. Coordinates were used in order to carry out the next step of photo rectification of the digging surface.

The excavation area was covered by little more than 50 photos taken from a digital camera with a resolution of 3 Megapixel. RDF[4] software, written and programmed by Prof. Francesco Guerra[5], was used to rectify photos. The digital photoplan obtained (Fig. 4) became the base to be inserted in the Tablet PC. Using a CAD software, such as Vectorworks v.11, the computerization and vectorialization of the structures and archaeological finds of the area being investigated was carried out.

The digital photoplan thus created concerned an area in which many stone fragments are present (Fig. 4). The excavation area had been used for drainage during the excavation and consolidation of the nearby *Capitolium*. It was possible to execute the vector drawing of stones and structures directly on the screen. This process was quick, and did not require any interruption in the archaeological dig.

[4] Free download http://circe.iuav.it/labfot/software/soft_rdf.htm.

[5] Scientific director of the Laboratory of Photogrammetry – CIRCE – University IUAV of Venezia (http://circe.iuav.it/).

Fig. 2 – Aerial photo of the archaeological area of *Grumentum* (Photo CIRCE-IUAV Venezia).

Fig. 3 – The archaeological area excavated during the Summer of 2006.

Manual drawing of a planimetry of a similar area would have demanded time and delayed archaeological work. By dedicating approximately a working day to the surveying phase of the photo targets and to taking photos which will constitute the base for the creation of the digital photoplan, it was possible to document this first phase of excavation quickly and accurately.

The area to be drawn was adapted in order to create a design using Tablet PC. It was not easy to close the polygons created through the CAD software using the digital pen equipment. A traditional mouse was used in addition to the optical pen. With the right hand the drawing was carried out and at the same time with the left hand the designed polygon was closed. In this way, we reduced the number of errors that would have been made by only using the optical pen. In fact, given the high sensitivity of the optical pen, there was a high risk of moving or lengthening the trace as it was drawn.

Conclusions

The final result is illustrated in Fig. 5, where the perimeter of the circular structure is shown. In the drawing it is possible to see the smaller circular structure and towards the angle to the left, the direction of the landslide. Moreover, we have also recorded the areas in which various limestone layers were present connected to the excavated circular structure. An area in the lower part of the drawing is documented in which various mixed fragments of tiles and stones are visible also

Fig. 4 – The digital photoplan (scale 1:10).

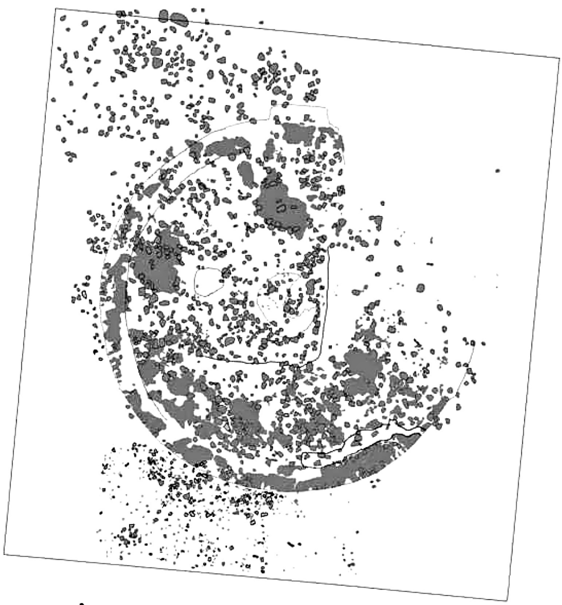

Fig. 5 – The final digital drawing from the photoplan (scale 1:10).

from the georadar prospection. The final result is a plan of the excavation area on a scale of 1:20 which reveals the structures and the distribution of the stone materials of the landslide with annexed limestone concentrations and tiles in various points of the excavation. In order to obtain the final result approximately 3 days were necessary.

Considering the level of precision of the digital photoplan the final drawing that was obtained was quite good. The process was fast, reliable and precise. Using instruments like Tablet PC facilitates the phase of surveying and drawing which, during archaeological excavations, are mostly done by hand. In those cases in which plan and section drawings are drawn by hand, they can be quickly digitalized afterwards in the laboratory with a Tablet PC.

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2nd Italian Workshop "Open Source, Free Software e Open Formats nei processi di ricerca archeologica" (Genoa, May 2007)

The 2nd Italian Workshop "Open Source, Free Software e Open Formats nei processi di ricerca archeologica" took place in Genoa on May 11th, 2007, locally organized by the grupporicerche of the Istituto Internazionale di Studi Liguri (IISL), the Istituto per la Storia della Cultura Materiale (ISCUM) with the support of Cooperativa Ipsilon.

The workshop was dedicated to the memory of Riccardo Francovich.

In this brief review I will try to summarize both what went on during the workshop, and the ideas and proposals that emerged during the final round table.

Soon after the 1st Workshop in Grosseto (Bagnara and Macchi 2006), concerns were expressed about the urgent need to move a step forward, both improving free software for archaeological purposes and revitalizing studies in the field of quantitative methods. For this reason this year's workshop was focused on data sharing and open access, from a scientific, technical and legal point of view. While data sharing is not necessarily linked to the adoption of Information Technology, it is certainly exposed by it, even though most problems are not to be found in the technical field. Focusing on data sharing may also mean trying to shift from computer geeks to computer-aware archaeologists, as well as not forgetting why it is important to pursue quantitative studies and to have large databases to analyze.

Regarding legal issues, thanks to the presence of Andrea Glorioso from the Politecnico di Torino we received a very detailed picture of the licensing framework concerning copyright, with some hints from an external viewer, which is what he is. His talk dealt with Creative Commons and Science Commons and was informative in many ways. It is intriguing (and dangerous) to investigate the domain of intellectual property because it merely comes to a matter of deciding whether we are "creating" our data, or just collecting facts. Facts *per se* are (or should be) free, as noted by a recent Science Commons initiative, and nobody can claim rights upon them, thus opening opportunities for some sort of public domain status for archaeological data.

On the other hand, if, as archaeologists, we are the original authors of our data, we can still choose to use some kind of license that allows use and redistribution of the results of our work (like the Creative Commons licenses are meant to do). Both of these scenarios go in the direction of an increasing number of databases and collections freely available on the WWW, thanks to the almost zero costs compared to traditional paper-based dissemination. In Europe, databases have their own *sui generis* "copyright" law, and that should also be taken into account. That of free (as in freedom) geographical data, without which a good part of archaeological data are pretty much nonsense, is a problem that luckily enough is being targeted at many levels by a much wider community than the archaeological one alone.

The Associazione Nazionale Archeologi participated with a talk about the negative situation of professionals in field archaeology, who often *de facto* are kept out of the scientific community and not allowed to publish excavations they conducted. The establishing of rules about intellectual rights on archaeological data is seen as a necessary step to guarantee freedom of research. Of course, this would also mean better chances to have more data publicly available and exploitable by scholars thus reducing the distinction between academic and non-academic research.

We already have plenty of tools to manage large collections of data. More of these tools are being currently developed and even published, even though it is rare to see analytical tools. This situation leads us to think that most analysis is still done by the archaeologist (and not by the machine), based on the results of a database (or GIS) query, strongly opposed to the occurrence of the expression "huge amount of data", a commonplace in archaeological computing literature. The major problem is, in fact, that there are too few databases publicly available, and not many researchers are keen to publish their data and "give them away" to the community. This attitude is plainly unacceptable in the case of state-funded research.

As Andrea Crosetti pointed out in this year's final round table, it could be said that trends in archaeological computing are not so exciting and there have not been many advances: we are using the same tools (e.g. GIS) as ten years ago, in the same naïve way as ten years ago. Most "evolution" seems to come from outside. This is clearly an issue for a group of people heavily committed to promoting free and open source software as a tool, in two senses: for revitalizing studies in quantitative methods, that are themselves a tool to enhance the overall quality of archaeological research.

Twelve months ago, right after the Grosseto workshop, a public international mailing list was created (with the generous support of the Italian Linux Society: http://www.linux.it/). At the time of this writing, the total number of subscribers is 88, mostly from Europe. Activity on the mailing list is not very intense, probably due to a lack of real-life meetings between members, but it serves well as a quick way to exchange news and discuss software. Subscription is open at the URI http://list.iosa.it/ and archives of past e-mails are available. Keeping our focus on WWW initiatives, a new "Quantitative Archaeology" wiki has been started as a support to all those who want to teach and learn quantitative methods using free and open source software. Work is in progress to reach a basic support for introductory statistics, while, in the very nature of wiki, everyone is allowed and welcome to add tutorials and code, like Loïc Jammet-Reynal recently did (Jammet-Reynal 2006). The wiki is at http://wiki.iosa.it/.

The final discussion was very interesting and a good number of people were actively involved. The presence of the University of Innsbruck was very much appreciated and their support for free software as part of an open knowledge project is really something other universities should try to emulate, giving students an opportunity to learn something they can turn into professional experience. This project was possible thanks to the collaboration with Arc-Team (http://www.arc-team.com/), who developed ArcheOS.

The ArcheOS GNU/Linux distribution (Bezzi *et al*. 2006), the only existing free software distribution created for archaeology, is heavily involved in the managing of excavation data and post-excavation data processing, using only free software like the powerful GRASS GIS. It is amazing to see how many tasks can be achieved using their DVD. Arc-Team, like the University of Siena, has supported the workshop since last year.

At the end of the workshop, I tried to summarize in four points the desirable roadmap to follow until next year:

1. Create a network, working side by side whenever we have an opportunity to do so. We have wikis, blogs, websites and a mailing list to share our experience, but physical meetings can play a major role in enhancing our "koiné". We should try to have more "hands-on" workshops where talks are just the start and not the objective, avoiding as much as possible the academic part of such events.
2. Students should find their way into this network, because what they want is to learn, not to hear about things (like in most conferences). Those teachers who are interested in spreading the philosophy of these workshops have necessarily to make their students aware of free/open source software and data sharing initiatives. Knowing each other is the best opportunity for cross-fertilization and augmenting of knowledge. In this sense, Benjamin Ducke's recent initiative to collect information about courses in quantitative archaeology and archaeological computing across Europe is one of the first efforts people should contribute to. Last year the 1st QMDAA (Quantitative Methods and Data Analysis in Archaeology) Summer School organized by the University of Siena was a good example of both education and informal meeting.
3. Many of us are writing code, and even full-featured programs. We have a simple way to share code, the GPL license, but there are still few cases of archaeological software under a free license. Of course, procedures and algorithms (best if packed as function libraries) are much more significant than GUI applications.
4. Sharing our data is a request that many of us have been receiving since last year. The situation is not as clear as for software, and "licenses" for archaeological data can be different from country to country, as much as the actual amount of shared data. There are many hypothetical benefits of a widely spread sharing practice, but I would exclude from this list the requests for transparency and objectivity of archaeological documentation (mostly from excavations) that are usually used as arguments for data sharing. I think we should look at existing monumental and long lasting projects, such as the *Corpus Inscriptionum Latinarum*, to really get the picture of what can be achieved when all existing data are out and available in a standard form. The UK Arts and Humanities Data Service (AHDS) is an example of a large collection of literature and data as digital resources.

Even though the overall situation in archaeological computing has not changed much since the late 80s (Huggett *et al.* 1998), we should note that some authors have referred to the introduction of the free software/open source philosophy as a "revolution" (Camporesi *et al.* 2006), and a major transformation not only from a technical point of view, bringing a chance for an actual step forward in the whole discipline (Bagnara and Macchi 2006).

Considering the various problems we could deal with, excavation data management is still the central issue of the majority of the projects that were presented. Remarks on the importance of standardization for archaeological documentation are a recurring theme, expressing a common and unsatisfactory situation that Francisci and Segata have tried to solve presenting their proposal of a new recording method using a geoarchaeological standard. This is just one of the many cases in which the use of Information Technology uncovers problems that have not much to do with computing itself, but rather involve "hard" topics like the formalization of knowledge, standardization, sharing of best practices. Archaeology, and Italian archaeology in particular, is partly missing the main objective of interoperability.

Next year, topics which will be dealt with include open formats, the WWW as a public "intelligent" library, open access archaeology (D'Ascoli 2005). Altogether they represent a new way of thinking archaeological computing that might possibly play a role in reshaping the current situation. The Semantic Web is the next big thing in knowledge management and the importance of machine-readable data and metadata is already at the core of some promising projects.

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Forthcoming Conferences

The Fifth International Conference on Science and Technology in Archaeology and Conservation

Baeza and Granada, ES. 7-12 July 2007

For information visit: `http://conference.legadoandalusi.es/en/`

Email: `takasheh@index.com.jo`

EVA LONDON 2007
Electronic Visualisation and the Arts

London, UK. 9-13 July 2007

For information visit: `http://www.eva-conferences.com/eva _ london/`

Email: `suzanne.keene@ucl.ac.uk`

Bridging Archaeological and IT Culture for Community Accessibility

Milano, IT. 10-11 July 2007

For information visit: `www.tarchna.org/conference.htm`

Email: `tarchna-conference@tarchna.org`

CIDOC 2007. Managing the Global Diversity of Cultural Information Documentation of the Universal Heritage to Support Universal Responsibility

Vienna, AT. 20-22 August 2007

For information visit: `http://www.cidoc2007.at/`

Email: `cidoc2007@paveprime.com`

ICOM/ICMAH Vienna 2007 – Museums and Universal Heritage History in the area of conflict between interpretation and manipulation

Vienna, AT. 20-22 August 2007

For information visit: `http://www.icmah.com/`

Email: `beier@dhm.de or marie-theres.holler@wienmuseum.at`

VSMM07 13th International Conference on Virtual Systems and Multimedia. Exchange and Experience in Space and Place

Brisbane, AU. 23-26 September 2007

For information visit: `http://australia.vsmm.org/`

Email: `australia@vsmm.org`

CIPA ATHENS 2007 – XXI CIPA International Symposium AntiCIPAting the Future of the Cultural Past

Athens, GR. 1-6 October 2007

For information visit: `http://www.survey.ntua.gr/hosted/cipathens_2007/index.html`

Email: `cipathens_2007@survey.ntua.gr`

ICHIM07
Digital Culture and Heritage – Patrimoine Culturel et Numérique

Toronto, Ontario, CA. 24-26 October 2007

For information visit: http://www.archimuse.com/ichim07/index.html

Email: `ICHIM07@archimuse.com`

12th International Congress Cultural Heritage and New Technologies Managing Uncertainty: Progress in Archaeological Research and Heritage Management

Vienna, AT. 5-7 November 2007

For information visit: `http://www.stadtarchaeologie.at/`

Email: `kongrarchae@m07.magwien.gv.at`

New Books

GIS and Landscape Archaeology. By H. Chapman, Stroud, Tempus, 2006.

The e-volution of Information Communication Technology in Cultural Heritage. Where Hi-Tech Touches the Past: Risks and Challenges for the 21st Century. Short papers from the joint event CIPA/VAST/EG/EuroMed 2006 (Cyprus 2006). Edited by M. Ioannides, D. Arnold, F. Niccolucci and K. Mania, Budapest, Archaeolingua, 2006.

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