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Urban Archaeology and Processing
Analysing the Data

Excavation, field walking, watching briefs, survey – in fact any archaeological activity accrues "things" – notes, plans, photos, data and any number of finds. To make sense of them and use the information they contain to contribute to the archaeological narrative they must be processed, analysed, and interpreted. Without these "next steps" archaeology makes no sense. Objects may be classified typologically according to form and material, excavation plans are studied topologically and topographically, raw stratigraphy is grouped into phases and a whole suite of archaeosciences, such as paleobotany, dendrochronology, isotope dating human anthropology or archaeolzoology, is at our disposal for scientific analysis and dating. This year's call is for sessions, workshops and round tables concerning processing, analysis and interpretation of archaeological phenomena – as always with a leaning toward urban archaeology and new technologies.

David Bibby | Benno Ridderhof (Scientific Committee)

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ABSTRACTS – ADVANCED ARCHAEOLOGICAL TRAININGS – HANDSON WORKSHOPS

Training 1 – Geodata processing with free software: gvSIG CE and the GRASS GIS plug-in
(Organiser: Benjamin DUCKE, Germany)

The free and open source GRASS GIS (http://grass.osgeo.org) offers a plethora of tools for archaeological data analysis. This, in combination with the software's superior performance, 3D capabilities and reliability, should make GRASS GIS the spatial analysis platform of choice for archaeologists and other social scientists. Unfortunately, the software also has a steep learning curve, which means that many potential users have shied away from it in the past.

However, with gvSIG CE (http://www.gvsigce.org), we now have a user-friendly, free desktop GIS that provides seamless access to GRASS GIS' geoprocessing modules.

Participants of this workshop will get a hands-on introduction to the use of GRASS GIS (version 6.4) from within gvSIG CE. We will look into a number of powerful GRASS modules and how to run them on input data in common formats (Shapefiles and GeoTIFF images). We will also look into batch processing large amounts of data and building complex processing flows with the graphical modeller. If time allows(!), a (very short) introduction to writing simple shell scripts for automated data analysis will also be given.

Notes to participants:

You will need to bring your own computer.

All software used in this workshop can be downloaded freely from http://www.gvsigce.org for Windows, Mac OS X and Linux systems (64 bit only!). This will include a version of GRASS GIS. You do not need to download or install any additional software. Please make sure to download and test the most recent version of gvSIG CE on your device before attending the workshop.

This workshop will focus on geoprocessing tasks and only very little time can be spent explaining the basic usage of gvSIG CE or even general GIS concepts. Therefore, you are required to have some basic GIS skills.

If you have worked with a software such as MapInfo, ArcView or QGIS before, then you will have very little trouble getting started with gvSIG CE. Otherwise, please make yourself acquainted with gvSIG CE before the start of the workshop.

Training 2 – Cultural Heritage Geospatial Infrastructures – a fundament for collaboration and exchange
(Organiser: Markus JOBST, Austria)

Most of us are used to manage their data with GIS systems. Publications and pictures of our CH data are one main result of our work and sometimes are widely used by others. The reason is that these artefacts were published and therefore are accessible. Beyond the GIS systems there is one development that also enables us to share our fieldwork with "the others". For this reason we have to share the contents by publishing the metadata and making the sources available, if we like to do so. And even if collaboration is not our aim, these Web-based systems allow us to efficiently manage our constantly growing datasets in the World Wide Web as the ARCHES project shows us (http://archesproject.org/).

This hands-on workshop on Cultural Heritage Geospatial Infrastructures leads through the basic paradigm of these modern mapping technologies. Simple examples in a well prepared software framework (totally based on open source components) explain the basic methods of the Web, Service-Oriented Mapping and its services, Metadata management, publishing of content and the creation of Spatial Data Infrastructures.

The aim is to provide an easy access to Spatial Data Infrastructures for Cultural Heritage topics and to understand world-wide initiatives for infrastructure harmonisation (like INSPIRE or the US NSDI). This workshop is held by the ICA [the International Cartographic Association, www.icaci.org] Commission on Map Production and Geobusiness [http://mapproduction.icaci.org].

Training 3 – Survey2gis: a flexible, open source solution for transferring survey data into GIS (Organiser: David BIBBY, Germany)

Written from scratch and distributed freely under an open source license, Survey2GIS is a compact and flexible solution for handling topographic survey data. It is capable of processing 2D or 3D point measurements into complex geometrical objects (points lines and polygons), including multipart features and polygons with holes. The output generated by Survey2GIS is ideal for direct use in GIS. Input data consist of one or several plain text files with coordinates plus attribtue data, as may be produced using a total station or GPS device. Output data will be generated in the common ESRI(tm) Shapefile format (2D or 3D), according to geometry type and with complete attribute data. This process can be fully steered using a user-definable parser, thus allowing flexible adaptation to different survery workflows and data structures.

The software is user friendly, easy to learn and feature rich with detailed protocolling to support quality assurance and consistent documentation of all processed data. During its development, high priority has been given to the generation of topologically correct output, suitable for quantitative analysis in GIS. This includes functions for the elimination of duplicate points, snapping to vertices and to polygon boundaries and modeling inset polygons Survey2GIS runs under Windows (XP – 8.1)and linux, either from the command line or via a graphical user interface. Survey2GIS is especially comfortable as a plugin for gvSIG-CE.

This software is distributed under the GNU General Public License. Its development has so far been funded and directed by the State Heritage Management of BadenWürttemberg, Germany

Features:

- Free

- Open source software for Windows, and Linux

- Configurable

- Parser to match different input data formats

- Verbose

- Protocolling of data processing

- Generation of 2D or 3D Shapefiles

- Complete creation of attribute data within GIS

- Topological functions: snapping, point reduction, insets, merging of multiple input surveyfiles

- Standalone or as gvSIG Extension

Tutorial:

This tutorial offers the opportunity to become aquainted with the basic functions and operations of Survey2GIS:

- Survey codes

- Input of survey data

- Configuration

- Shapefile output

- Topological Functions

- Automatic symbology-creation in gvSIG-CE

Tutorial structure:

1) Introductory presentation

2) practial step by step seminar with survey2Gis as gvSIG-CE-Plugin

Requirements:

1) Tachymetric surveying: basic knowledge

2) Desktop-GIS: basic knowledge (gvSIG CE will be used).

3) Notebook/Laptop (Windows XP through 8.1 or Linux*).

* Linux 64 Bit Systeme require32 bit libraries (e.g. "sudo apt-get install ia32-libs")

PCs will not be provided. Please bring your own notebook. A preconfigured installation of gvSIG CE with survey2gis as Plugin will be provided and can be kept after the tutorial.

Web presence at:

http://www.survey-tools.org/

http://www.gvsigce.org/

Training 5 – Digital recording of features, monuments and excavations
(Organiser: Stefan HOHMANN, Germany | Willem BEEX, The Netherlands | Giorgio VERDIANI, Italy) in collaboration with Kubit

In this workshop the participants will be able to work with a tachymeter, images and software in order to digitally create a drawing from (part of) a monument. The participants will also learn the several advantages and disadvantages of this method in order to fully appreciate this technique.

The workshop will be divided in three sessions:

- Working with a tachymeter/total station

- Taking useful pictures and using them for digital 3D modeling

- Working with a handheld scanner

For each session a specific set of information will be given to enhance the abilities and improve the skills about this survey work on monuments and archaeological sites.

To all the participants it is suggested to bring their cameras (if available) to check it and verify its possible enhancements to allow a better picture taking according to the general workflow presented in the workshop.

Max. 10 participants with basic or medium knowledge of measurement techniques.

Training 6 – Poster 2.0 – Reinventing poster design
(Organiser: Bert BROUWENSTIJN | Benno RIDDERHOF, The Netherlands)

In the last years the rules for creating a poster have become blurred. Posters are often used as an abstract for a presentation or for the presentation of a research. In most cases there is always a discrepancy between text and Picture. Also the layout of posters is of a questionable quality. This workshop aims to present guidelines to create a balanced poster. Balance between text and pictures, and a good layout.

Participants will learn how to setup a poster using simple tools available in the Adobe suite.

Maximum participants 10

Training 7 – Intrasis Workshop
(Organiser: Karin LUND, Intrasis, Sweden)

The documentation system Intrasis was released in a new version in spring 2013. Intrasis has become the hub for excavation and analysis data, where information is stored and understood by semantic relations. The possibilities of the Intrasis data model has been more utilised in this new version – making it easier to access and view data. During this workshop we will show documentation and registration for an archaeological excavation using Intrasis from survey, registration and analysis to publication of maps and drawings/plans including the following steps:

1. Intrasis coding and import of survey data
2. Registration of data (finds, samples, features etc.) and creating relations
3. Import of images and raster data
4. Analysis in Intrasis Wizards
5. Creating layouts and export
6. View relations data as graph

Welcome!

For more information about Intrasis: www.intrasis.com

Traning 8 – 3D Scanning in hard-to-reach places
Organiser: Bernhard MAYRHOFER, VirtuMake | Olga ZINCHENKO, Artec Group, Luxembourg

The workshop focuses on the high-resolution 3D digitizing of objects where gaining access for scanning equipment is either complicated, or impossible.

Examples include scanning in sub-Saharan Africa, remote areas of Ireland and at archaeological sites. The projects featured in the workshop were completed successfully thanks to the use of Artec Group's state-of-the-art portable 3D scanning technology.

In the workshop, attendees will first learn about the possibilities of 3D scanning in the harsh conditions of in-the-field research work, the difficulties arising during this process and possible solutions based on case studies of completed heritage conservation projects.

The workshop also features the practical demonstration of 3D scanning of various objects. Attendees are welcome to have a go and try out the 3D scanners for themselves. The workshop is facilitated by Artec Group and VirtuMake.

Round Table – New Perspective in authenticity, restoration and characterization of cultural heritage by using new Archaeometric Techniques
(Chairs: Recep KARADAĞ | Ali Akın AKYOL | Mahmut AYDIN, Turkey)

Archaeometry is the term that was used for the application of the methods of natural and fundamental sciences on archaeological finds to define and characterize. Non-destructive new archaeometric techniques started to be used in restoration, characterization, authenticity and for obtaining maximum scientific info from cultural.

Authenticity

In the cultural heritage science authenticity means whether the object is really what is claimed to be. Authenticity is relevant both for archaeological artifacts and art objects. The related problems apply to newly found archaeological objects unearthed by excavations, stolen and re-find objects or the objects present in a museum that is suspected to be a fake one placed instead of the stolen genuine one. In some occasions the question is whether an art work belongs to the claimed famous artist or not. Chemical compositions of cultural objects reflect the technology level at production date of the objects; this is directly related to authenticity. Therefore determination of chemical composition of cultural objects by nondestructive means has become vital for authentication. New non-destructive techniques (Portable-XRF, Portable Raman, and Portable XRD etc.) have allowed archaeometrists determine the chemical composition of both genuine and counterfeit objects for authentication.

Characterization and Conservation

Characterizations of Varnishes, metal, mosaics by Chromatography, Spectroscopic Technics, XRF and Solid State Nuclear Magnetic Resonance are a few Analysis Applications in the Field of Cultural Heritage. Another common used method is Scan Electron Microscopy which used in determination chemical composition of cultural heritage and let scientist to see microstructure of objects for restoration and characterization aim.

During this round table, the following issues may be discussed:

How can the authenticity of a painting be determined by using new nondestructive archaeometric techniques?

How can the authenticity of golden, silver and bronze objects be determined by using new nondestructive archaeometric techniques?

How can we determine whether the existing object in the collection is really the authentic one or it has been replaced by the fake one?

How can we determine chemical composition of dye, mosaics, glass and metals ?

How can we determine production way of textile, mosaics, glass and metals?

Please send us an abstract for a short presentation (up to 5 min)

A. A. AKYOL, Turkey

Laboratorıal based Archaeometrıcal Studıes in Turkey

Archaeometry is the term that was used for the application of the methods of natural and fundamental sciences on archaeological finds to define and characterize. The main areas of archaeometry are

dating, artifact studies, study of the man and his environment, mathematical methods, remote sensing, prospection and conservation & restoration.

Although the archaeometrical techniques have been used extensively in the world since 1880's, systematical applications are very new in Turkey. In the last three or four decades, departments of archaeometry in different universities were started to education and new laboratories were established and equipped for that purpose. Then, the project base researches on archaeological artifacts produced well organized limited groups mostly localised in different universities and in some institutions. Many scientists have been graduated from related fields and they started to produce archaeometrical data on defining cultural heritage.

The aim of this article is to define the scope of archaeometry and its interdisciplinary methodology related with the institutions in Turkey. And one of the practical examples of the laboratory MAKLAB (Material Research and Conservation Lab in Ankara) archaeometrical studies on historical materials will be shared.

Keywords: Archaeometry, archaeometry in Turkey, archaeometrical studies on historical materials

M. AYDIN, Turkey

New perspective in determination authenticity of Cultural Heritage by using New Archaeometric Techniques

Traditional way of determination authenticity of cultural heritage goods in Turkey and most of other countries is visual inspection. This way mostly lost its validity because of modern replication technology used by forgers. In USA and developed few European countries archaeometric techniques started to commonly used in last few years. Especially development of non-destructive spectrometers let archaeometrists to works on authenticity of cultural goods. Forgers mostly prefer to make fake metals objects that cannot be directly dated with archaeometric techniques such as C14 or thermoluminance. There are no archaeometric techniques that let archaeometrists to directly date cultural heritage goods made of metals.

Elementalanalysis contributes to authentication knowing the elemental composition and consideringthe information about the usual composition of the objects indifferent historical periods it can be established if the itemis original or fake.

Because of cultural heritage objects are unique; they need to be analyzed in non-destructive way. One of the most common used non-destructive spectrometer used in characterization of metal cultural heritage objects is Portable Energy Dispersive X-Ray Florescence (P-EDXRF). Because of P-EDXRF analysis results can be get in a few seconds (30s), qualitative and quantitative analysis, many analysis is possible from big objects and its lightness (1,5 kg) make P-EDXRF the most popular non-destructive spectrometer.

Keywords: P-EDXRF, authenticity, counterfeit, silver objects, gold objects

V. NICOLETTI | N. M. YAR, Italy / Turkey

Why non-destructive methods used on artifacts? Key Study: Ink of Qur'an ŞE 80

The Qur'an ŞE 80 of the Museum of Turkish and Islamic Art of Istanbul is one of the very important early Qur'ans that were brought to Istanbul from Damascus in 1911 among the so called "Damascus

documents". In the occasion of the exhibition "The 1914th Anniversary of the Museum of Turkish and Islamic Art of Istanbul" Qur'an ŞE 80 underwent specific conservation treatment financed by *Bank of America Merrill Lynch.* The restoration work was carried on by independent restorer Viviana Nicoletti on behalf of Art Restoration.

During restoration works which were written in ink in various colors were seen. In order to identify the different periods of the ink on this valuable piece of work, non-destructive analyses method was used. Therefore, with the help of an Italian team, scientists and restorers, XRF analysis of the pigments of the parchment and of the paper leaves was undertaken in February 2014, aiming at identifying the mineral compound present in the writing supports and in the graphic media. Such analysis will join the study of the bookbinding to verify the dating proposed for the manuscript on historical and paleographical grounds.

R. KARADAG, Turkey

Non-destructive Micro-analytical Methods for the Conservation of Textiles from Cultural Heritage

In this study, historical and archeological textiles, the metal thread, dyestuff and technical analysis were determined by micro and nondestructive analysis methods. Historical and archeological samples were provided from many museum collection and excavation area. Optical microscopy for the technical analysis, CIEL*a*b* spectrophotometer/colorimeter for the color measurements, HPLC-PAD for the dyestuff analysis and SEM-EDX for the metal thread analysis were performed.

Obtained results dictate decisions on cleaning, conservation and restoration steps. The most important part of characterization is chemical analysis of originally applied materials, since this enables understanding of the nature of chemical and physical degradation and helps to determine the proper cleaning methods. One of the most useful procedures for fast and simple determination of specific metals of interest is scanning electron microscopy equipped with an EDX detector (FESEM-EDX). This is a simple method which provides information on chemical composition of sample surfaces and chemical analysis of metals threads.

Keywords: HPLC-DAD, SEM-EDX, pigments, dyes, textiles

Keynote Speech
M. GRELLERT | J. SCHMID, Germany
Oriental Adventures – The excavations at Tell Halaf – Syria

In November 1899, spectacular archaeological finds were made near the current Syrian-Turkish border. During excavations at Tell Halaf, Max von Oppenheim discovered monumental sculptures and pictorial reliefs. They are part of an antique Aramaic palace, dating to the 10th or 9th century BC, belonging to the city-state of Guzana. An Assyrian palace was also discovered during subsequent excavations.

These were the beginnings of an excavation history, spanning over a century, to the present day. Military conflicts, including World War I and II and the current civil war in Syria have caused repeated set backs in research activities. Despite these problems, a virtual reconstruction created in 2014 allows valuable insights into how the fantastic combination of architecture and art work might have looked like, as well as illustrating the dimensions of this antique town. The most recent excavations at the site in 2010 uncovered the probably last results for some time to come.

This means, however, that the time can now be used to systematically investigate already existing data, and to verify hypotheses. The starting point for re-considering the architecture is the reconstruction attempts (first half of 20th century) by Oppenheim's first excavation architect and long-standing employee Felix Langenegger. Today, digital equipment has become a reliable and indispensible research tool. The digitalization of Lengeneggers drawings has exposed initial inconsistencies. The present reconstruction is a continuation of earlier attempts, complemented by the most recent archaeological findings. The reconstruction was created as part of an exhibition in the Bundeskunsthalle, Bonn. In the coming years, it will be used as a starting point for further analyses, and to assemble the isolated but diverse pieces of knowledge to create one or several possible reconstructions.

Tell Halaf is also an example of an altogether different fusion of digital knowledge. The great sculptures, which have been blasted into innumerable pieces during an air raid in World War II, have been meticulously re-assembled and scanned in a 10-year research project of the 'Vorderasiatisches Museum'. Missing pieces were supplemented and fractures were three dimensionally retouched. Other items of furniture have been reconstructed using archaeological finds. This is how the three dimensional virtual model of features and finds was assembled, portraying a moment in time of the current state of research regarding Tell Halaf.

Session: Complex Archaeology meets Complex Technology
(Chairs: Wolfgang BÖRNER, Austria / Benjamin DUCKE, Germany / Benno RIDDERHOF, The Netherlands)

Most of our towns and cities occupy locations that are as favourable for urban development today as they were hundreds or even thousands of years in the past. As a result, urban excavations frequently uncover some of the densest, most complex archaeological remains.

Exploring, documenting and preserving this uniquely important cultural heritage is perhaps one of our discipline's greatest challenges. This challenge is being addressed by new innovations as well as a substantial transfer of digital surveying and recording technology into field archaeology.

Urban archaeologists work in an environment of rigid financial regimes and political frameworks, at the same time facing the extreme pressure of modern property development and the high expectations of urbanites who wish to learn about and preserve their own roots. Currently, our profession is standing its ground with a mixture of regulations, sophisticated technology and highly formalised workflows. However, there is a wide-spread feeling that even this is just barely enough to keep up with the ever increasing complexity and magnitude of urban development projects.

This session's aim is to discuss and discover the challenges and promises of the current (and future) uses of computer technology in urban archaeoloy.

To this end, we invite papers that contribute innovative, insightful and controversial aspects to the topic of processing complex data in urban archaeology, including but not limited to…

- Integrated digital solutions (hardware and software) for data recording in the field,
- efficient methods for structuring, visualising and analysing complex excavation data,
- information systems for data storage, archival and retrival,
- software tools for spatial planning and decision support,
- strategies and methods for data mining and dissemination,
… as well as policies, licenses, guidelines and standards for the digital age.

J. E. ABRAHAMSE | M. KOSIAN, The Netherlands

The Atlas of Urbanization in the Netherlands. – A millennium of spatial developments

The Netherlands are an urbanized country. Over the last ten centuries a dense pattern of small, large, old and new towns emerged. How did this pattern develop and why do our towns look as they do? From Friesland to Limburg, and from Groningen to Zeeland, dozens of towns were built during the Middle Ages, most of them along rivers and main waterways. When the Dutch Republic became a world power in the Dutch Golden Age, large extensions were realized in Amsterdam, Rotterdam and Leiden. After a period of economic recession in the 18th century, the industrialisation caused some of these cities to prosper again from 1850 onwards. This not only led to a rapid growth of existing cities, but also to the emergence of new cities. Industrial centres like Tilburg and Hengelo and residential towns like Apeldoorn and Hilversum sprang up along the newly developed railways. Built under state control new cities emerged in the 20th century, like Almere, Emmen and Zoetermeer. The post-war welfare state meant that motorways, residential areas and industrial estates were rolled out at high speed over the country.

The study of urban history is fragmented in different disciplines and local in character. The Cultural Heritage Agency of the Netherlands and the Delft Faculty of Architecture have created an overview on the basis of scattered research. This atlas provides an overview of a millennium of urban development for the first time. By means of photographs, paintings and newly developed maps the growth and shrinkage of the Dutch cities is shown. Current topics are discussed, like re-use, redevelopment and the transformations of inner cities and urban fringes. This is the first national long-term overview of urbanization and urban practice in Europe. In our presentation, we will highlight the emergence and

development of the urban pattern and the morphology of the Dutch cityscape in the period from the Middle Ages and the early modern period.

Keywords: Urban history, urbanism, urban planning, architectural history, urban history GIS

F. BAKER, UK

Digitising difference. Storytelling on the rocks: Proto-cinema in Valcamonica, between the 2D and 3D worlds

The digital difference. Speaking as both an archaeologist and filmmaker, the author asks: What does working digitally bring the methodology of archaeologists working with animators and digital designers on complex material such as Rock Art. What are the dangers of digital for storytelling and visualisation when it comes to preserving the potential otherness of past societies and artists? The discussion will first be based on the case study of the rock art of Valcamonica (Lombardy) and the exhibition "Pitoti - the digital rock art of ancient Europe" shown in Milan and Cambridge and academically curated by the author with Dr Christopher Chippindale and produced with the CCSP Capo di Ponte. Secondly the paper will look at the research process that led to the current on going EU funded digital research project "3D Pitoti", with is being carried out by the universities of Cambridge, Bauhaus Weimar, Nottingham, TU Graz, FH St Pölten, as well as ArcTron, Archeocamuni and the CC SP, Capo di Ponte.

Keywords: Rock Art, Valcamonica, 3D digitisation, animation

C. BATTINI, Italy

Augmented Reality applied to the archaeological excavations

The technology that the market and scientific studies offer in this historical period allows to detect and to represent the cultural heritage more directly. The techniques of game engines allow to manage complex three-dimensional models on Mobile supports providing the ability to navigate the space virtually. The cultural heritage may well acquire a third dimension that is usually lost in the moment of printing a book.

The study presented in this paper concerns the ability to display three-dimensional models with augmented reality technology. Often you have to detect archaeological sites that subsequently must be dismantled in order to proceed with work on restoration projects. The project examines an excavation, carried out in a Florentine palace, detected with the techniques of structure from motion. During the excavation phases were encounter while some layers of periods of construction of the building. In order to keep the memory of this historical information in their complexity, it was decided to create a mobile app that allows you to see the three-dimensional model with a smartphone by framing a picture on a brochure. In this way any person can view the findings and the original morphology of the phases found during the excavations. To this model we have also added texts and images that allow describe in precise detail the archaeological excavation.

Keywords: Augmented Reality, Structure from Motion, unity, mobile

G. DIONISIO | A. M. JASINK, Italy

Usable but not suitable: traditional versus new technological display. The Aegean Collection in the National Archaeological Museum of Florence

The Aegean Collection of Florence is only partially exhibited to the public, being almost kept in the storerooms of the Museum. Nevertheless, such a rich and impressive collection has the opportunity to be shown beyond the boundaries of the Museum and, consequently, be available to the whole of researchers and common people through different and related scientific, technological and data processing methodologies. The focus of our interest is addressed not only to simple interactive or virtual applications, but also to diagnostic analyses and traditional restoration. The whole of these perspectives leads to a new light in archaeology and allows a deeper knowledge of the ancient Aegean objects and of the context of their production.

In this paper we are dealing with some specific analyses useful to obtain new data about ceramic samples: traditional and virtual restoration, diagnostic analyses, three-dimensional digitalization, and virtual application inside an interactive museum (MUSINT). As to the diagnostic analyses, we acquire useful data about the ancient pigments used on the ceramic surface to obtain particular chromatic effects. Virtual technologies and, in particular, digital restoration, are very useful methodologies in this context because they allow to manipulate and study the ancient ceramics without a direct contact with them. Moreover, virtual restoration allows to restore not only the shape but also the original decorative pattern of an ancient object, giving detailed information about its original condition.

Keywords: Archaeological collections, traditional and virtual analyses and technologies

F. GABELLONE | et alii, Italy

Methodological Approaches and ICT Solutions for Smart Cities

This paper illustrates the chief results obtained by the IBAM ITLab in the Cultura e Turismo: DiCet project and the Siracusa Energia project, both financed with National Operational Program (programmi operativi nazionali – PON) funds. These two projects pursue the objective of defining and producing innovative models, processes, and tools for the sustainable development of a smart territory by capitalizing on its cultural assets and environmental resources, and promoting and marketing their tourism offerings. From this standpoint, procedures were developed to compile technical models for an efficient management of 3D and 2D resources, and to define best practices and methodical protocols for quality certification and process standardization, capable of fostering cross-sector dialogue. The sites were identified as a function of a supply-and-demand analysis with regard to a placement on the market of innovative models and services based on the creation of hyper-realistic digital models and virtual scenarios. Particular attention was given to those uses that permit greater visibility, protection, and conservation of cultural assets characterized by difficult access, vulnerability, seismic risk, hydro-geological risk, etc.

In view of this, innovative models and tools were designed and developed for capitalizing on and exploiting cultural heritage, understood as an integrated and complex system conceived as a holistic model strongly based on the use of ICT technologies. Virtual enjoyment is understood here as a form of representing reality that accelerates and strengthens cognitive capacities, which is to say it becomes capable of generating extremely sensitive, "virtuous" learning processes based on metaphors of the real world, and thus easy to use and understand.

Operationally, our working group has made some Augmented Reality solutions available; these enable the interactive display – directly in situ and especially on mobile devices – of archaeological monuments integrated within the urban fabric. A simple solution allows the user to display an interactive 3D reconstruction directly on the real site, using the latest-generation gyroscope function. In addition to this, certain inaccessible monuments of the cities of Lecce and Catania have been virtualized, chiefly using image-based technologies and ultra-realistic laser scanning, to allow them to be visited remotely both via smartphone and on large virtual theatres.

Keywords: Smart Cities, Augmented Reality, Virtual Reconstruction

J. GSPURNING | S. LAMM | P. MARKO | W. SULZER | S. TIEFENGRABER, Austria

Geospatial Technologies for Investigating Roman Settlement Structures in the Noric-Pannonian Borderland – Selected Aspects of a New Research Project

A new research project, currently in the application stage, wants to contribute to the research into settlement structure(s) of the Roman empire in the territories of Flavia Solva, Celeia, Poetovio, Salla and Savaria.

In a preview of the project, we will present new methods to combine state of the art spatial analysis and remote sensing on the one hand, and archaeological evaluation of find-spots on the other hand, integrating geospatial and archaeological data from diverse sources and qualities ranging from 19th century find reports up to modern, GIS-based excavation documentation or ALS data, into a sustainable and accessible standard taking into account requirements of both geotechnological applications and data warehousing principles of the historical disciplines such as the CIDOC CRM. Based on this data model descriptive statistical methods will be employed to characterize the status quo in a designated test area in Southeastern Noricum, and to implement geographical concepts by GIS-analytic methods to gain new insights from the combination of thematically related layers. The result of this first attempt is the establishment of a sound geospatial and geostatistical workflow in a multidisciplinary approach of the involved researchers for the project, which can be used as a basis for further analysis with special focus on the spatial aspect.

Keywords: Settlement Archaeology, Landscape Analysis, Geostatistics, GIS

I. HERZOG, Germany

Analysing settlement processes in the Bergisches Land, Germany

The nearly complete list of Medieval settlements in a study area of the Bergisches Land, Germany, and a historical map of 1715 form the basis for analysing the spread of Medieval and early modern farms in this rural region. In this hilly study area with lots of small streams and at best moderately fertile soils, only few archaeological remains of pre-Medieval periods have been recorded, so most probably the population and the number of farms increased considerably during the Middle Ages. Previous studies derived the movement patterns from old trade routes in this region by least-cost path calculations and showed that locations of Medieval settlements are close to the fertile valleys rather than near the old trade routes. A drawback of these studies is that they do not take the size of the settlements into account. Moreover, they are based on static site distribution maps and do not reconstruct the spreading process. Settlement sizes (i.e. one, two, three or four farms, hamlets and

villages with a church) are shown on the early 18th century map depicting nearly all Medieval settlements known from historical sources as well as a small portion of additional settlements. The first step in reconstructing the spreading process is to identify patches for subsistence, i.e. possible locations of Medieval and early modern farms. Different hypotheses with respect to the origins of the spreading process are investigated by simulations. The search for a subsistence patch is modelled by an approach similar to Lévy walks adjusted so that they take the known movement patterns into account. A spreading procedure is considered to reconstruct the settlement process successfully, if the final distribution of farms is close to that recorded on the map of 1715.

Keywords: Simulation, Lévy walk, settlement patterns, movement patterns, GIS

S. G. MALATESTA | V. CIRILLI, Italy

The HyperColumna Project

Communicating archaeology to a non-specialist audience: this is the challenge the project HyperColumna want to perform. In a world increasingly crowded with information, the only truly limited resource is attention, which tends to capture only those experiences that are interesting and pleasant. The HyperColumna Project comes from a different conception of creating disclosure: it does not consider the user to be a passive recipient of the cultural message, but instead wants to involve him in a process of knowledge personalized and free of constraints. To achieve this goal, the project combines to a hypermedia content platform the potential of information technology, inspired by the frieze of Trajan's Column: HyperColumna makes immediately visible and livable the relationships between monuments, characters, historical events and places depicted in the very long bas-relief, connecting them with their reality and multiple contexts. In other words, it's a new approach to the cultural visualization and disclosure through user experience.

Within the installation at the Trajan's Markets – Imperial For a Museum, in collaboration with the University of Arkansas Rome Center, a demonstration version of the system is hosted, which also innovates the approach to the information technology interface access using the Leap Motion® technologies, that permits to control the digital interface with the only use of the hands. HyperColumna gives back to the Trajan's Column all its original communicative value, making it also a key to spatial and chronological access: through it, the visitor will be led to look with different eyes the surrounding archaeological heritage in its entirety, no more silent witness of bygone eras, but part of a wider and articulated question that comes to embrace also his present. Finally yet importantly, the technological format can be easily exported to other cultural heritage contexts.

Keywords: Trajan Column, leap motion, archaeological disclosure, hypermìedia contents

D. PLETINCKX | C. CAPURRO | D. NOLLET, Belgium

Reconstruction of the interior of the Saint Salvator abbey of Ename around 1290

Our work focuses on the research about and reconstruction of the Saint Saviour abbey in Ename (Belgium) in the 13th century, both in its architectural decoration and in its furnishing.

Aim of the reconstruction is the creation of a serious game with natural interaction (Kinect) targeted to school children visiting the site, that will allow them to virtually walk in the abbey and discover the daily life of monks.

We based our reconstruction on the large amount of historical sources and archaeological data that more than 25 years of extensive excavation provided. In the reconstruction of the furniture and the objects of the abbey, we also used a great number of iconographic sources, such as illuminated manuscripts. The educational game has multiple goals. It will be installed in the Provincial Heritage Centre of Ename, erected next to the archaeological site, and it will be deployed in a room on the top floor overlooking the archaeological remains. In this way, it links to the complex archaeological remains and shows the splendour of the medieval phase of this abbey. The reconstructed period also shows the scriptorium in which Martijn van Torhout, a well known medieval writer, was active.

A second important goal is the re-contextualisation of museum objects that have been excavated in the abbey's site. In the digital abbey, artefacts are shown in their original context and function both to help children to understand better their nature, but also to explain them the concept of heritage, and the reason why we spend effort and budget to excavate and preserve objects from the past.

The third goal of the project is a better interpretation of available archaeological and historical data. Reconstructing the inside of the abbey has improved significantly the understanding of the structure of the buildings, their function and interrelation.

Keywords: Virtual reconstruction, natural interaction, education, serious game, archaeological park

J. RÄTHER | E. SIEGLOFF, Germany
archaeoDox – Information management from the dig into the archive
The design of an archaeological database or the decision for a particular application often depends on special scientific interests or the requirements of a single project. In the context of the preservation and care of field monuments with the need to document everything from a find notice to a longtime excavation, from prehistoric sites to development led urban archaeology, the requirement profile is more complex. Besides the acquisition of homogenously structured archaeological information through both, staff members and external contractors, under varying operational conditions, the management of the increasing amount of digital files is a main task. Meeting those requirements archaeoDox was on the one hand developed as a common relational database for scientific information like the documentation of finds, contexts, stratigraphic relations etc. and on the other as a document management system. It builds up a file system upon the documentary steps of each project which can be searched directly within the application linked to the scientific information. The development of archaeoDox was undertaken by derbrillIT in cooperation with the Archaeological Museum Hamburg and the State Archaeological Department of Schleswig-Holstein, where archaeoDox serves as a standard application at archaeological excavations and for the revision of archived documentary and the storage of digitalized analog files. The technology of archaeoDox is open source and a community edition of it was published as free software under GPLv3 in April 2014. A general aim of the development of archaeoDox was a simplification of working processes within a data-centric architecture. archaeoDox can be applied as a client-server-application as well as a stand-alone-application on site and a geo-data extension is currently planned. archaeoDox is also considered to be a necessary step towards the possibility of long term digital preservation later on.

Keywords: Excavation database, document management system, open source, free software

L. SALIGNY | X. RODIER, France

Study of the urban dynamics by a new computer application

The study of the urban fabric and the spatial dynamics of urban space is based on an understanding of the city as a complex system composed of individual historical objects. The OH_FET model which we developed since 2004, is based on this approach of urban space. It describes the historical urban object as the Cartesian product of three basic dimensions: function (social use), space and time from the works of Donna Peuquet in geomatics and James Allen in artificial intelligence. Although the heuristic potential of the model have already been proven to work on the cities of Tours and , more recently, Vendome in France, the integration constraints, the designing and data manipulation imposed by the model were too much complicated with the software available to allow the broadcasting of its use.

With support from the European Regional Development Fund (ERDF) and the Burgundy region, we have developed an application in Python programming language, connected to a spatial database (SpatiaLite or PostGre/GIS). This application consists of different modules. The first module allows to manage automatically the designing of spatial and temporal features like Historical Objects component, within the constraints of OH_FET model. The second module products on one hand some analyzes of urban transformations, on the other hand visualizations about the temporal dimension (chronographies). The treatment of the temporal dimension are display by graphs concerning, for example, the functional transformation of urban space in time.

The case studies have so far focused on the transformation of districs or small towns. The further development of the application will focus on the treatment of the temporal dimension from relative chronologies across the excavation scale for which experimental work has shown the relevance of the model.

Keywords: Urban transformation, temporal dimension, chronographie, Python language

J. SCHULDENREIN, USA

Geoarchaeological Methods in Urban Archaeology: A Case Study from Manhattan Island

Rapid urban development is decimating the buried vestiges of ancient landscapes at an exponential rate. In New York City, the impacts of the World Trade Center disaster coupled with rapid development has all but eradicated the buried evidence for the city's complex landscape history. Diverse projects undertaken several years before and after the disaster facilitates landscape reconstructions of this area, which straddles the dynamic margins of marine, estuarine, and terrestrial eco-zones at the glacial margin. Prior to initial 17th century Dutch occupation, Manhattan's topography was steep to undulating, preserving many of the glacial features characteristic of a terminal moraine setting. Euroamerican and industrial age land use left a complex but well stratified urban sequence. Landform chronologies bearing on occupation since the earliest Native American occupations (Late Pleistocene/Early Holocene) are preserved albeit in fragmentary form. Holocene shoreline reconstructions help model rates of sea level rise. The urban fill stratigraphy illustrates how the early Euroamericans modified shorelines to stabilize Manhattan Island and established this city as the USA's primary commercial center. For most projects we use minimally-invasive geoprobes to identify baseline stratigraphies. Sedimentological, palynological and molluscan records facilitate environmental

reconstructions that are dated by radiocarbon. It is possible to model changing shoreline ecologies with detailed core strataigraphies that can be "retrofitted" to geotechnical cores obtained by engineering geologists. The structure of NYC compliance archaeology requires that individual sites be investigated in accordance with access limitations and permitting requirements. Different subsurface approaches are therefore used for each project. However, with GIS it is now possible to synthesize reconstructions across the broader urban footprint. The types of projects that gave rise to this synthesis exemplify the ways in which development driven research will pilot the course of geoarchaeology in the 21st century.

Keywords: Geoarchaeology, subsurface coring, GIS

R. VAN LANEN, The Netherlands

Surveying past movement: how large-scale landscape archaeological research can aid to the reconstruction, analyses and prediction of Roman and early-medieval infrastructure in the Netherlands

The early-medieval Netherlands witnessed major changes in landscape, economy, demography and also possibly climate. Archaeological evidence throughout north-western Europe, including the Netherlands, indicates severe demographic decline and changing settlement patterns in the late-Roman and post-Roman periods. To what extent the inhabitants of the early-medieval Lowlands adapted to the increasingly changing landscapes and how this is reflected in large-scale patterns is generally unknown. Trading and communication routes will have changed in these periods, but are difficult to reconstruct.

Since no maps of these periods are known in the Netherlands, and archaeological finds related to infrastructure rare, a different approach is needed to reconstruct, predict and analyse Roman and early-medieval infrastructure. We developed a network-friction model (NFM) which allows us to locate landscape obstacles and corridors for potential translocation in low-elevated areas, such as the Netherlands. By surveying available archaeological data on: burial grounds, demography, infrastructure, isolated finds, settlements and ships we were able to combine network friction with archaeology and reconstruct zones containing potential routes. Results show that this approach correctly models over 80% of the infrastructural finds and is very useful approach for reconstructing (and predicting) route networks in in low-elevated areas, such as the Netherlands.

Keywords: Geographical Information Systems (GIS), Early Middle Ages, Roman Period, Historical Infrastructure, Route Networks

Session: Rubble, Ruins and Reading, specific approaches in analysis – Trying to let the remains telling the story
(Chairs: Stefano COLUMBU | Giorgio VERDIANI, Italy)

The ruins always give a great suggestion, but their observation, their reading and their study allow to imagine the original aspect of the building. Every ruin has a powerful evocative aspect, but only a correct analysis permits to pass from it to a credible vision of how it was. The stones, the materials composing the walls and the remains of an archaeology site as well an existing architecture, can tell a

lot. The different use of these materials together with the construction techniques are meaningful traces and evidences for the scholar, and can give confirmations or open new hypothesis about the reasons of an architecture or a part of a town.

The knowledge on chemical, mineralogical-petrographic and physic-mechanical properties of the materials used for the construction of structures (stones, mortar and concrete, bricks, etc.) may offer a valid contribution to the recognition of the different wall techniques and the construction phases of an ancient residual building starting from its mortars and giving interesting indications about its production. The technologies and manufacturing processes and preparation of these lithoid products can become very useful for understanding the cultural level of the civilization. A proper analysis of material properties in architectural structures can reveal to the researcher/scholar the technical-construction choices and intent of the constructor during the ancient yard. At the same time the reading of proportion, grids, pattern, reference models, can be a great completion to the interpretation of the original aspect of a place.

The contemporary digital tools allow to correlate these kind of meaningful data to 3D and 2D models, creating a new and powerful knowledge instrument.

This session will be aimed to collect contributions from this kind of studies, suggesting the integration between survey, excavation, geometric interpretation, inverse design evaluation, as well as geological and petrographic-physical analysis to investigate subjects from the architectural to the urban scale.

L. CIPRIANI | F. FANTINI; Italy

Ravenna's Archaeological Heritage: technique integration for accurate documentation through 3D digital models

The historical centre of Ravenna belongs to UNESCO World Heritage list since 1996 because of its outstanding universal value related to mosaic art, Byzantine and Late Antiquity architectures, and also because those monuments, in particular baptisteries and churches, provide crucial evidences related to the evolution from Roman prototypes.

With the purpose to test the possibilities offered by the synergy of acquisition technologies and entertainment applications, the paper will explain the results of a pipeline aimed at improving the quality of 3D digital models from Structure from Motion software and active sensors. The surveying and restitution integrated methods will enhance portability, colour representation, and lighting simulation under different conditions of 3D assets.

The results achieved through this case studies will provide to different actors in the field of conservation and valorisation of Cultural Heritage, a dynamic and robust interactive tool, based on 3D digital models and new advanced devices, capable to increase the quantity of information provided during a conventional visit of a cultural site, where mosaic art is present.

Keywords: SfM, Digital Models, real-time, visualization

S. COLUMBU | A. CAZZANI | A. RUGGIERI, Italy

Relations between static-structural aspects, construction phases and building materials of San Saturnino Basilica (Cagliari, Italy)

The construction site was used several times: in a first phase, in the republican era of Roman domination it hosted, probably, a temple whose height could reach 25 meters; in a second phase, during the Roman Empire, it was used as a burial area. Then around IV-V century AD a first Christian Basilica made of a naved building with an apse was built there, at the center of a large monastery. Subsequently in a third phase in VI century AD a Byzantine Martyrium, with a Greek cross-shaped plan, was built: the central part of it, supporting a dome is still standing. Finally after 1089 the church was given to Marsilian monks who deeply renovated it and changed its shape converting the plan to a Latin cross.

A macroscopic material analysis shows the presence of various rocks, whose use appears to be inhomogeneous during all construction phases. Sedimentary rocks (limestones, sandstones, calcarenites etc belonging to local geological formations) are generally used for masonry structures. Marbles, mostly coming from abroad and previously used in Roman buildings have been adopted for architectural elements (columns, capitals, and so on). At a lower extent there are masonry blocks in Oligo-Miocenic volcanic rocks and seldom stone materials which are not originally from Sardinia. Both mineralogical and petrographic tests (e.g. XRF, XRD) and the most important physical properties (porosity, density, water absorption coefficients, compressive, flexural and tensile strength, etc) show that many of the more representative samples of rock materials (like limestonss, calcarenits) are often highly decayed, with a corresponding reduction of their mechanical strength.

A structural analysis is particularly useful for helping in clarifying the historical evolution of the building, checking reconstruction hypotheses and assessing the true residual strength of the more important parts. An example, a FEM analysis of the Byzantine domed part is presented here.

Keywords: Static structural analysis, stones, Byzantine architecture, reconstruction, physical properties

S. COLUMBU | M. MARCHI | M. PALOMBA | F. SITZIA, Italy

Alteration of stone materials on Sardinian medieval monuments: physical, chemical and petrographic analysis for their restoration and preservation

Sardinian medieval monuments are mainly made up by volcanic rocks (pyroclastites/ignimbrites), minor granitoids and sedimentary rocks, that show a more or less significant chemical-physical alteration.

Mineral-petrographic features, physical properties related to petrogenetic processes, as well as manufacturing, strongly influence type and intensity of stone-decay.

The granitoids show an alteration degree less than the other rock-types, due to low porosity (<10%) that does not favour an easy absorption of circulating solutions, thus avoiding the water-rock interaction and hydrolysis. In a few cases, a physical intra-crystalline decohesion, that involves a rounding of the sharp edges of ashlars, can occur, while, in chemical/mineralogical terms, oxidation patinas and the chloritization of mica minerals can be observed.

The pyroclastites/ignimbritites, widely used in medieval architecture for the excellent workability, are

affected by greater alteration due to the different mineral/chemical composition, mainly including glass (>70%), and physical features (higher porosity, 20-45%) due to a variable welding degree. Chemical alteration is not always evident since is more slow than the physical degradation (with macroscopic forms of pitting, exfoliation, alveolation). The limestones with low porosity (<10%) show an alteration that generally occurs on the outer surface of ashlars (with solubilization-reprecipitation processes), while sandstones and calcarenites (porosity >25%) generally show an advanced stages of decay, with physical macroscopic forms similar to those of the pyroclastites. The chemical alteration is also present, in particular on carbonate cement. To make a contribution to the preservation of sardinian monuments, this paper suggests a new approach to define the different alteration-modes of rocks in function of their local exposure to the weather, studying: 1) the changes of physical properties on surface of stone (porosity, water absorption, micro-morphology) determined through laboratory tests and photogrammetry observations, 2) the alteration phases present on surface (e.g., secondary minerals, soluble salts) determined by mineralogical (XRD) and chemical (XRF) investigations.

Keywords: Medieval monuments, mineralogic-petrographic features, physical properties, chemical-physical decay, Micro-photogrammetry

O. HAUCK | P. KUROCZYŃSKI, Germany

Cultural Heritage Markup Language – How to record and preserve 3D assets of digital reconstruction

The lecture presents the on-going project "Virtual reconstructions in transnational research environments – The web portal 'Palaces and Parks in former East Prussia'" – Funded by the Leibniz Association from 2013 till 2016.

Within the multinational (Germany, Poland and Russia) and interdisciplinary project (art historians, historians, architects, geodesics and informatics) we design a virtual research environment based on the interactive 3D models of the baroque palaces linked with a semantic data model.

The project examines the methodology of the 3D-Computer-Reconstruction of Cultural Heritage according to the unsolved problems of certification, classification, annotation and visualization, in particular within the discipline of digital reconstruction of architecture, interior design and interior decoration. Our approach affects the overall process chain with a focus on the development of the "Cultural Heritage Markup Language" (CHML), a bracket to integrate diverse information (para- and metadata), including XML-inline description of the geometry, material, light and camera settings.

The project preliminary results introduce the appropriate acquisition, analysing and interpreting of data for digital reconstruction purposes. In addition, the project deals with 3D documentation of Cultural Heritage, semantical modeling, data management, to the point of „virtual museum" and new forms of interactive presentations within cutting-edge solutions for WebGL. It shows the integration between survey, geometric interpretation and visual representation of generated knowledge in semantic web.

Keywords: 3D digital reconstruction, architecture, documentation standards

A. MERLO | A. ALIPERTA, Italy

The fortified settlement of Bivignano. Computer graphic tools in analysis and its representation

The fortified settlement of Bivignano (Arezzo, Italy) is a part of a large system of castles developed between the eleventh and twelfth centuries in a minor valley of Cerfone river, branch of Tevere river. Founded by the family of Count of Bivignano, the castle grows together with the noble residence (a "casa-torre" typology with a plan dimension of 10.25 by 7.50 meters, still intact for 9.30 meter) and with the adjacent church of Santa Maria (rebuilt in the seventeenth century on the original early medieval chapel). The rest of the buildings consist of housing and service areas, which have been in use until the mid-seventies.

Today the castle is in a deep abandonment also due to the continuous looting that deprives him of the architectural elements easily re-usable elsewhere, accelerating the degradation processes.

The research group DM_SHS (Documentation and Management of Small Historical Settlements) in charge at DiDA (Dipartimento di Architettura dell'Università degli Studi di Firenze) has recently started up a digital survey campaign aimed to the production of 3D models, useful not only to provide documentary evidence of the entire castle and to support stratigraphic, metrologic, and structural/diagnostic analysis, but also to try out advanced texturing procedures, makes available by the computer graphics (like baking and UV parametrization), capable to correlate the results of such analysis to models themselves; this allows a more appropriate reading of the information and facilitates the dissemination of the results through the web.

The paper will therefore be able to assess the progress of scientific research in the particular field that gathers together digital survey, 3D modeling and computer graphics for knowledge, enhancement and dissemination of the cultural heritage.

Keywords: Digital survey, 3D models, advanced texturing procedures, computer graphics for knowledge

A. VIRDIS | R. MARTORELLI | L. TANZINI | F. PINNA | S. COLUMBU | M. MARCHI | F. SITZIA | M. PALOMBA, Italy

Romanesque and territory. The construction materials of Sardinian medieval churches: new approaches to the valorization, conservation and restoration

This paper is intended to illustrate a multidisciplinary research project devoted to the study of the constructive materials of the Romanesque churches in Sardinia during the "Giudicati" period (11th - 13th centuries). The project focuses on the relationship between a selection of monuments and their territory, both from a historical-architectural perspective and from a more modern perspective addressing future restoration works. The methodologies of the traditional art-historical research (study of bibliographic, epigraphic and archival sources, formal reading of artifacts) are flanked by new technologies: digital surveys executed with a 3D laser-scanner, analyses of the materials (stones, mortars, bricks) with different instrumental methods: X-ray fluorescence (XRF) and inductively coupled mass spectrometry (ICP-MS) for chemical composition, X-ray diffractometer (XRD) to determine the alteration phases (e.g., soluble salts), optical microscopy and electronic (SEM) to study textures, mineral assemblages and microstructures, termogravimetric/differential scanning, calorimetric analysis (TG/DTA) for the composition of the binder mortars.

This multidisciplinary approach allows the achieving of important results in an archaeometric context:

1) from a historical point of view, with the possible identification of ancient traffics, trade routes, sources of raw materials, construction phases, wall textures;

2) from a conservative point of view, by studying chemical and physical weathering processes of stone materials compatible for replacement in case of future restoration works.

Sardinian Romanesque architectural heritage is particularly remarkable: about 200 churches of different types and sizes, with the almost exclusive use of cut stones. Bi- or poly-chromy, deriving from the use of different building materials, characterizes many of these monuments, becoming also a vehicle for political and cultural meanings.

The paper will present some case studies aimed to illustrate the progress of the project and the results achieved.

Keywords: Art-historical approach, construction stone, petro-archaeometric approach, provenance, alteration

Session: The State of 3D Modeling of Cultural Heritage in the Age of Augmented Reality, Xbox Kinect, UAVs, and the Oculus Rift

(Chairs: Gabriele GUIDI, Italy / Bernard FRISCHER, USA)

The purpose of this session is to take stock of the current state of the art of 3D modeling of cultural heritage objects of all scales (from a vase or statue, to a building or an entire landscape). It seems particularly opportune to do so in light of the dramatically lower costs of devices for 3D data capture and display. Papers fitting one or more of the following three descriptions would be especially welcome: (1) cultural heritage projects exploiting Augmented Reality and/or immersive, 3D display devices such as the Oculus Rift; (2) projects collecting 3D data using low-cost devices and methods such as SfM, Kinect or Unmanned Aerial Vehicles; (3) 3D modeling projects (especially those involving reconstructions) that have as their goal not simply illustrating previously existing knowledge of the past but serving as tools to see or understand features of the past that can only emerge after we have made the 3D model. Papers should concentrate less on the "how" of 3D modeling (fairly well understood by now) than on the "why" (i.e., what is the scientific gain in knowledge that results from applying the new technology?).

Topics falling into category (1) should, whenever possible, provide the results of summative assessment: we are interested not simply in bright ideas and clever demonstrations but in proof of concept or full-scale deployment. For example, if a claim is made that AR can help promote better public understanding of cultural heritage, did the pilot AR project actually produce measurably positive results?

Topics falling into category (2) should ideally include a comparison of the results of using low-cost and high-end data gathering devices. What are the strengths and weaknesses of the low-cost approach? Is a low-cost device good for certain cultural heritage applications but not others? For example, we welcome a paper comparing the resolution and accuracy of 3D meshes of a statue resulting from a SfM approach vs. one resulting from traditional scanning.

P. GIANNI-FALVO, Italy

Augmented Reality in museums: Design and evaluation with cognitive technologies

AR technologies applications in museums have been abruptly growing in the last few years, but the metrics used for evaluating their impact on the museum public is often based only on qualitative analyses. This simplified approach may give results strongly biased by the "interpretation" of the perception each user gives according to his culture, tradition, attitude to the use of technology, etc., rather than the actual psycho-physiological response induced by the immersion in a synthetically enriched environment. Recently the chapel inside Palazzo Medici in Florence, frescoed with the "Procession of the Magi" by Benozzo Gozzoli, was used for an experiment of guided perception with the support of multimedia technologies and Augmented Reality in the workshop, "Procession in time through to the splendor of the interior epiphany." The aim of that project was to integrate aesthetic-historic-philological studies relating to the artistic product and its genesis, directing attention at the response of the observer in relation to the aesthetic experience. The immersion itinerary was thus focused on the analysis of the observer's capacity to enter into contact with the work of art through the sensory channels and on the manner in which this relation can be augmented. This fostered a phenomenological relationship with the work of art, and the relation in turn became the subject of research to detect the psychological and physical reactions, and in particular the emotional response. The visitors were involved in an impact assessment detected through qualitative (collection of data in the form of interviews, comments, visual images and documents) and quantitative psycho-physiological tools. The latter are based on the measurement of certain physiological parameters (heartbeat, respiratory rate, oxygen consumption, brain mapping etc.) that express psycho-emotive correlates. The reactions occurring during the itinerary of images, symbols and sounds are investigated to discern the reaction of the entire psyche-soma system, and in particular the emotional reactions.

Keywords: Assessment, Augmented Reality, cognitive technologies

G. GUIDI, Italy / B. FRISCHER, USA

Photomodeling vs. traditional 3D data capture of cultural heritage artifacts

In recent years, photomodeling solutions for creating 3D models have matured to the point where they have become part of the Virtual Heritage toolkit. We will begin our paper by showing some recent examples of photomodeling of ancient sculpture from Hadrian's Villa (Tivoli, Italy) and of the archaeological site of Cosa in Tuscany (Italy). Photomodeling has the advantage of requiring only a digital camera, not a dedicated piece of equipment such as a laser or structured-light scanner. This difference results in an immediate savings in cost since even a professional-level digital camera is less expensive than a scanner. The time needed for photographic data capture is typically measured in minutes, as compared to the hours needed by users of the dedicated devices. There is a price to be paid for this convenience: the 3D model made photographically does not have the same complexity as one made by laser or structured-light scanning. The former typically consist of 4 to 15 million polygons whereas the latter can measure in the hundreds of millions. Models in the range of 4 to 15 million polygons are useful for visualization, but they are usually not sufficiently detailed for offering the level of detail required for scientific documentation of cultural heritage artifacts. This paper reports on

research into the question of how the model produced photographically —whatever its size and resolution—compares in terms of accuracy to a model produced by a dedicated device. Our test case will be the statue of Caligula in the Virginia Museum of Fine Arts, of which we have 3D models made in the traditional way (Faro Arm with data processed by Polyworks) and through photomodeling (Agisoft Photoscan and Autodesk Recap).

Keywords: 3D modeling, photomodeling

A. MAGNELLI, Italy

Use of Oculus Rift for an immersive "time-shift" experience in the Medieval Ages

The paper will describe an Oculus Rift application in a cultural heritage immersive exhibit, developed by the ICT Company ETT S.p.A., for the Medieval Castle in Monteverde, located in Avellino province (southern Italy) and dating from the ninth century. The exhibit – now under construction – will open in August 2014.

The project is a development of the approach that advanced technologies can be used to enhance visitor engagement and 'absorb' them into the storyline.

This concept is applied in the castle Throne Room, where the visitor sits on a rotating chair and – wearing an Oculus Rift device – has a 360° view of a 3D reconstruction of the hall, complete with detailed and life-like furniture and fittings. In this way, visitors experience a real 'time-shift' into the atmosphere of the medieval period, aiding storytelling and transforming them into an active participant in the 'story' narrated by the historical site.

The project will exploit Oculus Rift's features in order to obtain – as a final result – a deep-level immersive virtual reality environment. It creates the sensation of being entirely transported into a virtual three-dimensional world and can provide a far more intuitive experience than screen-based media. By removing an interface layer between the user and the experience, Oculus Rift has huge potential and will be able to have deep emotional impact on users. It has the enormous ability to deceive the brain into feeling that a particular situation or setting is 'really there!'

Keywords: Oculus Rift, ICT, advanced technologies, virtual reality

T. NAGAKURA | W. SUNG, USA

Multirama: Augmenting Architecture in Exhibitions

This paper introduces an application of Augmented Reality (AR) technology for presenting large and complex spatial designs, and discusses its benefit for museum exhibits especially with physical models.

We assembled a low-cost prototype that uses common handheld devices and widely-used marker-based sensing method.

Architecture and urban forms are difficult to present in museums. A building usually is too big to fit in an exhibition room, and removing architecture from its site to display in a museum would lose some essence since its design is strongly tied with surrounding context. Alternatively, use of traditional scale models, photographs, and drawings is a way of translating the original into useful representations commonly deployed by professional architects. But these methods fragment the building into isolated forms of different media and projections, and ordinary audience is often left clueless about the original

architecture. For instance, tests show it is difficult to relate a section with a scale model of a building, or to locate the viewing position of a photograph on the floor plan.

What are almost lost in this translation and cause difficulties are the spatial relationships amongst architecture and various forms of its representations. To resolve this situation, we built Multirama, an AR-based prototype, and loaded it with digital media contents about a Renaissance villa designed by Andrea Palladio. On a table, the installation exhibits its 3D-printed partial model, and audience use tablet computers for viewing it with selectively superimposed augmentation, which includes a photogrammetric model sampled through a fieldwork on the building site, geometric models illustrating the foundation and roof tectonics, as well as plan, section and elevation drawings depicted in Palladio's canon, The Four Books of Architecture.

This system capable of simple synchronization of views demonstrates an effective, intuitive means to help audience minds integrate diverse forms of spatial representations.

Keywords: Augmented Reality, architecture, xxhibition, spatial representation, design media

P. RODRÍGUEZ-NAVARRO | T. GIL PIQUERAS, Spain

3D-MUSEUM: Prehistoric movable Art. From the Palaeolithic to the Metal Age

This paper reports on a project to digitally scan and model a number of existing prehistoric art objects in the collections of the Prehistoric Museum in Valencia as well as the archaeological sites where the objects were found. The 3D models, along with related metadata, will be made available at the museum and via the Internet. The goal is to allow researchers and visitors to have a full visualization of the objects. The technology to be used inside the museum is a combination of Augmented Reality and Virtual Reality.

Once the project is implemented in the museum, it is hoped it will completely change the experience of visitors and researchers. They will be able move a virtual object with their fingertips and to manipulate it without endangering the actual artifact. Furthermore, users will be able to visualize objects in the museum's collections that are in storage as well as related items in other museums. In addition, the visitors and researchers will be able to use their smart phone or tablet to view a virtual image of the caves where the artifacts were found.

Keywords: 3D modeling, Augmented Reality, Virtual Reality

Session: Archaeological Field Survey and Prospection: Interpretation and Analysis
(Chair: Willem BEEX, The Netherlands)

Visible and known sites are usually well understood, registered and protected. But there is still much Terra Incognita. These "blank areas" are not only our only a source for new information, but they are often less protected, even if they are potentially pearls in the crown, regarding the heritage of a country.

Archeological survey and prospection, whether traditional or "high tech", is the only way to avoid such a waste of knowledge and heritage. But archeological survey alone is not enough. Science and heritage must also validate the information provided by those surveys – information that has or will be gathered. Bearing in mind that data can originate from such diverse sources as, say, a large area

archaeological and geophysical field survey at the one end of the scale through small scale test trenching to augering at the other end of that same scale, how do we define analysis criteria? How do we interpret our gathered data? This session invites you to provide examples of data from anywhere within the wide spectrum of (geophysical and archaeological) survey methodology, and especially approaches to analysing and interpreting that data.

W. BEEX, The Netherlands
Introduction for the Session

Archaeological Field Survey and Prospection is mainly used for three objectives: 1. A scientific hypothesis; 2. Heritage Management; 3. The location of a future archaeological excavation. And of course these objectives may overlap. It is important, however, to realise that the outcome will always be a sample. The implication of this last sentence is, that no survey or prospection can give a valid prediction without a valid quantifiable method. In this context it also has to be said, that a so-called "complete survey" is always an illusion. "Completeness" in archaeology can never be achieved…

One major problem for any survey or prospection is, of course, how to deal with an area. In general there are three solutions: 1. Simple random sampling; 2. Stratified sampling; 3. Systematic sampling. Each method has it's own advantages, but simple random sampling seems very impracticable in most archaeological cases. Another major problem are the environmental variables. They may in fact be the most difficult problem to tackle. Biases due to "variable archaeologists" will also be included with this topic. Several theoretical and practical examples will be mentioned in this introduction. Hopefully they will inspire the questions and discussions afterwards.

Keywords: field survey, prospection

J. COOLEN, Austria
Scatters, cropmarks and anomalies: integrating field survey data in the Kreuttal area, Lower Austria

Until recently, fieldwalking was considered the only prospection method that could target large areas alongside aerial archaeology. Hence, many landscape archaeological projects mainly rely on fieldwalking data. The drawbacks of using surface data are well-known but have hardly been systematically studied in Central-European archaeology. This paper will present the preliminary results of a field survey project in the Kreuttal area in Lower Austria, which is part of a PhD-project at the University of Vienna. The survey is part of a larger case study carried out by the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology, which combines large scale geomagnetic surveys, aerial archaeology and remote sensing as well as targeted excavations and geoarchaeological research. Various field survey and sampling strategies were applied both on known and newly discovered sites as well as so-called off-site areas to study patterns of prehistoric land-use. The systematic and, more importantly, equal application of various prospection methods allows for a comparison of results on multiple scales. Rather than ranking the 'most' and 'least successful' method, this case study aims to show how they can mutually benefit and lead to a more complete understanding of past human activities and the archaeological record.

Keywords: Fieldwalking, integrated prospection, landscape archaeology, Neolithic

M. COZZOLINO | F. FASANO, Italy

The Latin Colony of Aesernia: integrated researches related to urban geo-archaeology realized through a combined use of historical sources, archaeological survey, 3D photogrammetric reconstructions and non invasive geophysical prospections

In this paper we present the results of integrated researches related to urban geo-archaeology realized through a combined use of historical sources, archaeological survey, 3D photogrammetric laser scanner and non invasive geophysical methods such as ground high resolution penetrating radar and geoelectrical tomography. The analysis of the Latin Colony of Aesernia is proposed.

The city, founded in 263 BC, was developed on a river terrace bordered by steep escarpments and was surrounded by walls built using the technique of polygonal opus, opus quadratum, opus reticulatum and opus incertum. The temple of the Latin colony of Aesernia, was built in the place considered by the colonists the most dominant within the walls of the city and it was localized at the junction of the particular road system of the city consisting of a cardo major, with orientation north-south, and different parallel decumani with east-west orientation. Even the Latin colony of Aesernia possessed same thermal baths, both public and private, located about 800m to the south by the southern-east boundary of the city wall. However the position of the forum and the theater of the city is uncertain.

Geophysical surveys and 3D photogrammetric reconstructions carried out within and outside the city walls have provided interesting data filling many gaps in the knowledge of the colony. The integration of multiple systems of sources for the realization of a global study was very useful for the comprehension of the planning of archaeological research and the sustainable management of the cultural heritage.

Keywords: Latin colony of Aesernia, archaeological survey, 3D photogrammetric reconstructions, non invasive geophysical prospections

M. COZZOLINO | E. DI GIOVANNI, Italy

Geophysical Prospection applied to the historical Centers

The appropriate representation of the conservation status of a Cultural Heritage constitutes a primary element of knowledge in order to guarantee the success of a project concerning its valorization and fruition. In this context the use of non-destructive geophysical methods such as electrical tomography, georadar and electromagnetism system is a cognitive tool immediately prior to any enforcement action for restoration. In particular, they have a very important role in the redevelopment of historical city centers and they are helpful in situations where, for example, areas not yet built, within limited areas by ancient walls of the original settlers of the city, are destined to the construction of works with public value and it is therefore necessary to map the territory in a predictive way or even in redevelopment projects of historic buildings for monitoring the state of conservation of the same, or in the recovery of buried ancient structures beneath new buildings in the framework of exploitation of the original structures of the city. In this work three examples of application of non invasive geophysical prospections in the context of rehabilitation of historic centers are proposed: Frigento (Avellino, Italy), Alife (Caserta, Italy) and Nicosia (Cyprus).

Keywords: Geophysical prospections, historical centers, conservation

K. HANUS | E. SMAGUR, Poland /Australia

Filling the gap. Investigation of moated sites in NW Cambodia

Prehistory of Cambodia is overshadowed by impressive heritage of medieval Khmer Empire and its splendid capital of Angkor. However prehistory and early history of this part of continental South-east Asia is equally interesting, thus we devoted our research towards understanding settlement patterns of this region. Almost half century of the civil war resulted in relatively obscured knowledge about the archaeological landscape beyond the Greater Angkor. To change this state of affairs we have decided to propose research project based on spaceborne prospection of four provinces of NW Cambodia. This region is especially important, as the sites of eastern Cambodia and NE Thailand were under elaboration of scientists from UK, New Zealand and USA in 80's and 90's, however the gap between them (Tonle Sap basin) was never properly surveyed.

Our paper will discuss the research routines that we adopted for identification of the moated sites. Excavating a moat was a complex and labour-demanding task that required certain level of social organisation. That makes, in our opinion, moated sites special in the settlement hierarchy. As the earthworks are still visible in the landscape it is possible to identify the changes in the topography on the satellite images. Beside presenting the procedures of site-identification, we shall also present our interpretation of the sites and its hinterland. The innovation of our project is the first holistic attempt to reconstruct archaeological landscape of Tonle Sap basin, as well as recognize pre- and early historic sites for better protection and management of the heritage in NW Cambodia.

Keywords: Settlement patterns, Cambodia, Southeast Asia, moated settlements

F. U. SCELZA, Italy

The GIS of the territory of Poseidonia-Paestum

The paper concerns the implementation of GIS of the territory of Poseidonia-Paestum, developed within the urban planning of the municipality of Capaccio (Italy). Its construction involved the systematic collection, comprehensive and integrated of all available information and the construction of supports for the monitoring of archaeological remains.

The work involved the creation of an archaeological cartography, useful for the purposes of the administration, protection and research.

The data collected were processed to produce thematic maps, spatial analysis and statistics, with the aim of evaluating the archaeological potential of the area. Through operations overlap, control and analysis of documents, a systematic process of rationalization of the management of Heritage has been implemented. From this point of view the archaeological map constitutes the basis for storage of geo-referenced spatial data and alphanumeric, developed as an open system, which can be used by other GIS systems.

The system allows to distribute the recoveries in the territory with different degrees of reliability, to know which areas have yielded ancient evidence and which others can potentially hide in the subsurface traces of ancient occupation. The system can assist the action of territorial protection and, at the same time, ensure its more effective planning. It offers the meaning of a dynamic area that does not remain stuck in the peremptory administrative acts, such as archaeological restrictions, but binds the land use and the real nature of the archaeological finds.

The system is built according to an open approach, understood as the ability to share maps by several Institutions: Local Authorities, Research Institutes and Archaeological Superintendence.

Keywords: GIS, urban planning, archaeological data collection, archaeological investigations

Session: Processing old/old fashioned excavations-a useful struggle for information?
(Chairs: Ingeborg GAISBAUER | Christoph OELLERER, Austria)

Dealing with the results of old excavations means a big challenge for each scientist. Usually there is a multitude of findings to be dealt with, but the documentation tends to be somewhere between meager and simply nonexistent.

Is it still recommendable to go through the trouble of processing and publishing of old/old-fashioned excavations when - at the same time - resources are dwindling while archaeological activities increase?

Which are the different ways to approach this topic?

Papers for this session should either deal with the cardinal question if it is beneficial enough to be engaged in working with old-excavation data or not, or they should focus on different ways to approach this special kind of archaeological information. Different strategies in working with "old-fashioned" documentation as the main or even only source might be topic of a paper as well as processing relevant informations to make them available for a new archaeological project.

D. BIBBY, Germany

Ludwig Leiner's Last Laugh

In 1872 Ludwig Leiner, apothecary,city councillor,antiquary, scholar and self appointed city archaeologist wintnessed the digging of a narrow trench for a small gas pipe traversing the Cathedral Square (Münsterplatz) supplying Konstanz`s then new city lighting-system. He reported and published his observation in short statements in diverse learned journals of the time in succinct, clear wording, though without any sketches or illustrations.

During the following decades, his observations were repeatedly quoted in archaeological publications, though they were never given much weight. In some cases their very validity was questioned, even though Leiner described what he considered to be the remains of Roman architecture and, over the decades, the question of the Roman settlement of Kon-stanz has been one of the great remaining archaeological mysteries of the City. Why were Leiner's observations so poorly received, not taken seriously or even misinterpreted by an-tiquaries and archaeologists? Where there there perhaps hidden motives? Or did simple misinterpretation of his note in the absence any sketches or plans lead to their negation?

During the Cathedral Square excavations in Konstanz 2003-2005 the gas trench seen by Leiner was revealed, slicing through the middle of the site. And it was once again possible to see what Leiner saw.

Finally the questions on his observations that had remained open for 130 years could be answered. Where archaeologists over the years right to make little of what he reported? Or, in the end, did Ludwig Leiner indeed have the last laugh?

Keywords: Antiquary, Romans, interpretation, excavation

Ch. BLESL | I. GAISBAUER | D. SCHÖN, Austria

Reset and Start – The reanalysis and new presentation of an old excavation in Vienna's historical and topographical core

The Archaeological department of the Federal Department for the Protection of Monuments curates and secures analogue and digital records from archaeological interventions, observations and research projects in the Austrian federal area since 1850. The archaeological sites and monuments record and also a new monuments information system (archaeological and architectural monuments), which is currently being developed, also supply concrete data about historic and modern research institutions, finds and records depots, research history, literature and geodata from past excavations. The increasing need to reanalyse sites, which are "lost" scientifically as well as in terms of conservation, makes this central knowledge base all the more important.

In a period of tightening finances and considering the increasing scarcity of undisturbed deposits in the built-up city centre, research into urban lives has to be rethought. The reassessment of older earthfast or structural archaeological research can lead to new results as many new methodological approaches have emerged in recent decades, thus making it possible to analyse contexts in a fresh way and to arrive at new research questions. An interdisciplinary approach can be particularly helpful in scrutinising familiar material and reinterpreting it, if necessary.

Evaluation and re-evaluation processes of this kind concentrate on controversial questions and/or excavations, not the least for financial reasons. The particular approach to the material, and with it an accessible and transparent praxis, are primarily dependant on the extent and condition of the record and the finds material, of course, but the (in)completeness and character of partially published excavation results can also be relevant. Prepublications, older publications and nearly-published topics often result in the establishment of models, which go on to overshadow new discussion processes and, by persisting, obstruct new approaches and alternative suggestions. Particular care and above all a rigorously self-critical attitude are necessary in order to avoid a prejudiced approach in evaluating the material.

Keywords: Beginning of settlement, reinterpretation, new methodological aproach

A. HAAK, Estland

In the middle of a small town: reanalysis of excavations next to the market place of Viljandi, South Estonia

The boom of rescue excavations arrived in Estonia in the mid-1980s. As a result, there are numerous archaeological projects, the documentation of which has remained unfinished. Some of the sites are of key importance for understanding the development of a certain place, such as the medieval town of Viljandi, where the only large-scale excavations next to the town market place (1993–95)are the subject of this presentation.

The main aims were to assess the possibilities to reconstruct stratification, plot structure and the overall importance of the site with changes in time. To achieve this, comparative analysis of the main remaining sources: 1) written notes of the excavation leader; 2) skitches and drawings; 3) photos; and 4) specialist analyses has been conducted. In the presentation I will discuss the problems met during the retrospective analysis, and the main expectations as well as problems that were encountered. As a

result, it was established that the reconstruction of stratigraphy was the most difficult task, but absolutely vital for more specific use of find analysis and for the interpretation of other specialist data. An assessment of the level of existing documentation in regard to the methods and resources available will give a more realistic estimation of the feasibility of the planned approach. In our case, the role of the site in the development of the town was given additional details, but for a more detailed development scheme, the excavations with the methods and tools available today would give several additional impulses. To conclude, it was certainly worth going through the existing material, especially as no more excavations of that scale are likely to take place in the forseeable future, yet even small-scale studies at the same property might increase the potential for interpretation of existing data.
Keywords: Town archaeology, retrospective analysis, Eastern Baltic, find analysis

V. IMMONEN, Finland
Extracting information through reconstruction: Two case studies of old urban excavations in Turku, Finland
The quality of old urban excavations can differ enormously from site to site, even if they are close to each other, and their fieldwork is more or less of the same age. In such situations data collection should be as detailed as possible. Yet it is also vital to know the history and aims of the fieldwork, and the contemporary intellectual context as well. This paper examines two sites as case studies. They are situated at a distance of two kilometres in Turku, Southwest Finland. The first site comprises the ruins of a 13th-century cathedral and bishop's residence enclosed by a dry moat and embankment. Most of the area was excavated in 1898–1902. The second site is a Dominican convent, possibly from the 14th century, covered by the modern city structure. It has been investigated in several phases of fieldwork since 1901. Both sites are fundamental for understanding the urban history of Turku: the cathedral site as the predecessor of Turku, and the convent as one of the main factors influencing the urban development. The two cases show a stark contrast in the quality of fieldwork documentation and artefact preservation. Since they have remained without a synthesising modern study, the sites have become a bottleneck for further archaeological research. In the 2010s a team of archaeologists has begun to re-evaluate the data from the sites. The project has digitised and combined the old excavation maps, and created a digital database of the finds. The results so far have shown that the previous research was incorrect in assuming that the old excavations could not provide any new insights. Moreover, it has become apparent that this work is not only a matter of extracting information, but also of reconstructing the history of the fieldwork in detail.
Keywords: Fieldwork data, re-evaluation, Middle Ages, history of research, Finland

B. RIDDERHOF | J. BAZELMANS, The Netherlands
Dorestad: The Final word. (And they said it could not be done)
Six years ago the Dorestad Project" started with the specific aim to try to digitally disclose all the analogue material (with the emphasis on the old excavation drawings) from the excavations carried out at Dorestad (modern Wijk bij Duurstede) in the last 150 years. Was it possible to vectorize all the 4500 individual drawings from the different excavations from different years into a usable and coherent format? If so can the result be used in the analysis of all the individual historical periods of this site and

can it be connected to the written administrations of the different find categories. And most important could the result be used in creating an archeological map of the town and surrounding area that could be used by the city administration of Wijk bij Duurstede and State Heritage to devise future policies concerning new excavations in Dorestad.

Now six years later we can say yes! All the drawings have been vectorized into a coherent system that is being used at the moment by Researchers like Raphaël Panhuyzen and Stijn Heeren to rewrite the story of Dorestad. The new digital map is also the cornerstone of the conference held later this year at Leiden. It is a conference solely dedicated to Dorestad.

This presentation will show you how it was done and some of the results which were derived from the digital excavation map. One of the most important is that Dorestad was not an organically grown settlement, but from the Roman times till the late Middle-Ages, it was planned. Finally the map can pinpoint which areas in the city of wijk bij Duurstede are important for future excavations and which not.

Keywords: Digitization, analogue, material, heritage, city development

S. STEAD | J. WHITSON-CLOUD | D. OLDMAN, UK

Exploring inferences, time and space in the annotation of museum catalogues: The Sloane virtual exhibition experience

Modern digital museum catalogues differ from historic manual catalogues in that the record boundary is virtual, in the digital and physically on the page, for the manual. The history of the edits in digital systems can only be determined if the change history is explicitly recorded or if periodic snapshots of the data are preserved (although this only gives periodic aggregates of edits). In contrast the pre and post edit states of each edit and annotation are visible on the page in a physical catalogue volume. Card index systems vary in their completeness in this respect, as in some circumstances the card is replaced rather than updated. This has the effect of producing an aggregate of edits similar to a periodic digital snapshot.

Within the catalogue entries there are many possible interpretations of the use of geographical place names. For instance they can refer to the place of manufacture, the region of use, the place of collection, the region of a particular culture or the origin of the manufacturer. Each such interpretation has a different semantic meaning and consequently a different mapping to the CIDOC Conceptual Reference Model (CIDOC-CRM).

Similarly dates and other temporal appellations can have many meanings: date of manufacture, date of collection, date of accession into the museum, date of record compilation and/or editing or significant dates in the history or provenance of the object. Again these different meanings have different mappings to the CIDOC-CRM. In addition to these content elements, there are spatial and temporal relationships between the catalogue entries and annotations in historic manual catalogues and between annotations in card index systems. These too have particular mappings to the CIDOC-CRM. This paper continues the work on these different CIDOC-CRM mappings in the context of catalogues of the Sloane collection. In particular it will look at harnessing the mark-up of the entries and annotations to allow the documentation of inferences made from them.

Keywords: CIDOC CRM, museum catalogues, inference mapping

Session: "Analysing the Dead" – Archaeological anthropological and forensic recording and analysis of human/animal remains.

(Chairs: David BIBBY, Germany /Ann DEGRAEVE, Belgium / Karen WILTSCHKE-SCHROTTA, Austria / Raphaël PANHUYSEN, The Netherlands)

Previous sessions at this conference on "Archaeology of Human remains – Burial Archaeology and Forensic Aspects" showed the potential of a forum where archaeologists, historians, fieldworkers, anthropologists and forensic scientists come together to consider aspects of dealing with the dead from various points of view. The exchange of methods, ideas and experiences proved fruitful to all present. It is therefore appropriate to continue this theme into 2014.

Papers concerning the archaeology, anthropology and forensics of human/animal remains are invited. Subjects may include burial rites ranging from prehistoric through to modern times. Graves and human/animal remains from contexts as varied as ancient cemeteries, modern municipal graveyards, mass graves of warfare or genocide, experimental archaeology, studies of taphonomic processes as well as forensic reports, modern or historical disaster or crime scenes and/or traumatology serve as examples. Analysis is this year's main theme. The focus will therefore be on the analysis of assemblages of human remains. Ideally papers will discuss methods and concepts integrating the results of multiple disciplines. Papers addressing questions on how to apply new analytical tools like aDNA, isotopes and chemical analysis and how to evaluate the results of these methods are welcomed. What can we learn from DNA analysis? What does local mean in a provenance analysis? What can we learn from the burial record about living in the past? Papers may focus on the technology and concepts of analyzing new and old burial data, but papers presenting an overview of regional developments and trends based on the systematic analysis of burial data are also welcomed.

C. BARROSO | F. NETO | A. L. SEABRA, Portugal

Piecing together terminology in bioarcheology: defining concepts

Recent data has shown that there is a great diversity of vocabulary related with bioarchaeology and funerary archaeology employed in technical and scientific documents produced in Portugal. This phenomenon reflects, the lack of an uniform criteria in the application of concepts reflecting the circumstances and scientific preferences of the author, and revealing the subjectivity associated with the gathering of on field information during archaeological work.

The lack of a standard framework limits data interpretation, by restricting a systematic approach to the information gathered and, consequently, impairing the comparisons amongst bio-demographic and socio-cultural main features of Past Populations. Identifying this problem and its consequences led to the work that is currently being developed and that comprises the standpoint of reference authors in this matter, considering their contribution and presenting a proposal for the definition of the selected concepts. This strategy intends to produce a uniform language to be adopted in technical reports. It's our hope that this approach could lead to a better understanding of archaeological field reports, increasing their informative potential, that could later feed a bioarchaeological database.

Thus it is our aim, with the present communication, to present the first effort of an ongoing project, to establish a common standard of main concepts on bioarchaeology.

Keywords: bioarcheology, funerary archaeology, concepts, definition

J. CARVER, UK

The charter house 25, a window to the Black Death

In March 2013, 25 individual graves were discovered during construction work for London's Crossrail project. The graveyard appeared remarkably orderly, neat rows of graves were laid out in at least 2 distinct layers. Historical sources refer to a large burial ground in this area of London set out specifically for victims of the Black Death in 1348, however many previous excavations in the locality had never revealed evidence for this supposed mass burial. Were these individuals a small sample of the thousands of victims of Europes Black Death pandemic attested to have hit London in late 1348? What was the relationship between the layers in terms of dates, and what was driving an apparent change in orientation of the graves between the initial layer the subsequent phase? Traditional archaeological methods enhanced with forensic tests including Carbon 14 dating, aDNA , isotope and osteological analysis have been carried out.

What have these been able to add to the interpretation? Traditional archaeological stratigraphy, historical research and modern scientific techniques are all combined in this paper to build a case study illustrating the difficulties of working with small samples and the impact in particular of recent techniques in ancient DNA testing on our interpretations. A picture of disaster management and the causes and reactions to disease in 14th century London emerges and raises further questions regarding the location of the many thousands of victims that are still unaccounted for.

Keywords: Europe, London; Black Death, forensic techniques

C. M. MELISCH | I. GARLISCH, Germany / P. RAUXLOH | N. POWERS, UK

Medieval space and population

An osteological and GIS based research into the medieval population of Berlin with comparative study of contemporary assemblages from London. In September 2013 we started an international collaborative project between Humboldt-University of Berlin and Museum of London Archaeology (MoLA), which centres on the osteological study of medieval population as recorded on the excavations at St. Peter Square (Berlin) from 2007-2009. By comparison of this assemblages with contemporary cemeteries excavated in London, the project aims to provide new insights into the lives of medieval Europeans, and the social and environmental context in which they passed them. There is great potential in a study combining the two medieval populations of Berlin and London. Such a comparison can provide a truly intra-European perspective on comparative matters such as diet, life style, health care, longevity and disease. Within the Berlin site, there is also an opportunity to examine the arrangement and use of the cemetery over time. How an individual's status, health, age etc. may be reflected in the location or manner or their internment. This again could be usefully compared with the same analyses already completed on major London cemetery sites, particularly that of St. Mary's Spitalfields. This potential has been unlocked by the use of the single context recording and planning methodology on the St. Peter's site. This enables the granular comparison of individual traits within a true spatial and stratigraphic context. It allows these dimensions to return to the centre of the analytical matrix, and will enable the investigation of intra-cemetery organisation.

The work in 2013 did concentrate on carrying out a rapid assessment level survey of 150 individuals. We prepared and processed the existing spatial data into a relational database and to a GIS environment.

Keywords: GIS, osteology, cemetery, spatial data

A. MURPHY, UK

Lost, But Not Alone: Burial records as a means of determining absolute taphonomic loss by age in cemetery populations

The rate of loss of human bone in burial contexts is a topic which is of interest to archaeologists and forensic scientists alike. In excavated cemeteries it is frequently contended that large portions of the initial burial population, especially children, are rapidly lost through taphonomic processes. Burial records are one under-utilized means of assessing this attrition in cemetery populations. Such records provide a glimpse into the health risks of the population and furnish an initial mortality estimate, which allows for the study of taphonomic loss. Three excavated historic period cemeteries (St. Benet Sherehog, London N=187; Alameda Stone, Tucson N=1166; and the Voegtly Cemetery, Pittsburgh N=555) were compared to associated parish burial records (St. Benet Sherehog N=1513; San Agustin N=5099; and Voegtly Church N=806). The resulting mortality profiles were fitted against Model West life tables. Though very demographically different from one another, all cemetery records demonstrated plausible infant (0 – 1.9 year-old) mortality rates, ranging from a relatively high 52% to a moderate 21%. Mortality estimates derived from the osteological evidence in this age category were consistently 5 – 7% lower than those obtained from burial records for the same cemetery. The absolute loss of individuals varied markedly between samples. However, it was found to be quite similar across age groups within each cemetery, with attrition in the infant category only 3 – 14% greater than losses among adults.

Keywords: Osteology, burial, demography, archives

F. NETO | A. L. SEABRA, Portugal

What to do with data: Portuguese information system for anthropological and funerary data

The Directorate General of Cultural Heritage (DGPC) central administration service with responsibilities of management, salvage, rescue and valorization of cultural heritage assets, has the underlining obligation of maintaining an up to date inventory of archaeological materials . As such the DGPC develops and updates an archaeological heritage information system – Endovélico, ensuring the recommendations upheld by the La Valletta Convention (Malta, 1992). Thus, besides constituting an inventory of heritage records based on archaeological field reports, it works as well as an integrated system, indispensable for the development of national politics for heritage defense and value. Given the high quantity of archaeological reports (from both salvage and research) containing biological and funerary data, a specific recording model was developed as a means to manage and potentiate this information. This way the systematization of this data intends to enable their access to researchers and professionals assuming that the biological heritage is an important resource for the knowledge of Past Populations, their socio-cultural contexts as well as national idiosyncrasies and

Humanity itself. This communication aims to present the data base along with some associated issues and future strategies for development.

Keywords: Database, inventory, bioarchaeology

R. PANHUYSEN, The Netherlands

United in a grave, analysing multiple burials in Merovingian Maastricht

Research question

Multiple burials are defined as inhumations of more than one individual in a single burial context. These burials have often attracted interest from the public and regularly are featured in the media. However, to archaeologists they remained rather enigmatic and therefore received only rarely systematic attention. Changes in the perception of multiple burials and advances in archaeological methods and analytical techniques have led to the publication of a number of interesting case studies. This paper investigates whether the study of multiple burials within a confined space and time frame provides clues to a better understanding of this phenomenon.

Approach

This paper will provide an overview of the number, location and content of multiple burials in Merovingian Maastricht. Data will consist of excavation data, analysis of post-depositional processes, anthropological examination and aDNA analysis.

Results

Multiple burials have been excavated at three sites: the Servatius church site, the Boschstraat site and the Borgharen site. The majority of multiple burials consist of an adult individual and one or more children. Detailed excavation methods applied at the Borgharen site provide a more detailed view of the timing of the chain of events leading to the creation of a multiple burial. Analysis of aDNA has shown that the individuals in one of the multiple burials from the Borgharen site were most likely members of a single family. The implications of these results for the interpretation of other multiple graves in Maastricht will be discussed.

Innovations

The innovative aspect of this approach lies in the fact that the prevalence of multiple burials is studied in one area and with a focus on a specific time interval. Also the integrated use of data from various analyses is still not the standard.

Keywords: Burial archaeology, multiple burials, taphonomy, physical anthropology

E. PEREZ, France

Ages of children and burial rites: Evolution of child graves organization in medieval cemeteries

Age can be seen in a biological and social dimension, because it is the determinant of numerous social behaviors which vary with time and place. In this context, children are a specific group: they are characterized by fast growth associated with the division of childhood into stages related to biological and cognitive development, sociocultural practices as social representations.

However, the use of demographic age groups in the anthropological analysis (0-1, 1-4, 5-9, 10-14, 15-19 years) limits the observations, because this division is artificial and is not representative of childhood in all ancient societies. Using hagiographic and normative sources, which highlight specific

ages like 7, 12 and 14-15 years, I propose to apply a new method of distribution of children in "social" age groups, adapted for the Middle Ages (0-2, 3-7, 8-12, 13-17 years).

This new approach shows the essential role of the age in burial rites and organization of child graves in medieval cemeteries, from 6th to the 12th centuries AD. Indeed, the progressive establishment of parish cemetery during this time, characterized by the presence of a church, reflects a profound change in the social system of death management . Churches polarize the dead's ground and children under seven years-old are grouped against the church's walls, in a general movement which affects numerous churches in Gaul from the 9th and 10th centuries AD.

Keywords: Children, cemetery, burial rites, Middle Ages, palaeodemography

C. RADU | N. SZEREDAI | D. ANDREA | O. PONTA, Romania

Applying a biocultural approach in the analysis of the Late Medieval/Early Modern population from Gheorgheni (Romania)

Our presentation focuses on the study of the human remains found in the Late Medieval/Early Modern cemetery of the Romano-Catholic Church from Gheorgheni (Romania). The funerary assemblage is composed from two samples: the first containing human commingled remains (MNI=57), and the second representing the individual burials (N=27). For the former we inferred the minimum number of individuals (MNI) by applying standardized methods for dealing with human commingled remains (Adams, Konigsberg 2004). Moreover, the skeletal elements were analysed in order to determine paleodemographic and paleopathological data. The individuals from the undisturbed graves were analysed in terms of representativeness and preservation, estimation of age at death, sex determination, paleopathological investigations, traumas and fractures analysis, and metric measurements. Furthermore, the resulting data for the entire skeletal assemblage was explored from four directions: the paleodemographic profile of the population, evidences of interpersonal violence, nutritional and occupational stress indicators, and individual pathologies. Among the latter, there were osteochondritis dissecans, elongated styloid process (Eagle's syndrome), and lytic lesions. Trauma and fracture study was done using macroscopical and microscopical observations, but also XRD analyses. Cribra orbitalia, porotic hyperostosis, and linear enamel hypoplasia were used as nutritional stress indicators. Osteoarthritis and Schmorl's nodules were analysed both for their presence and degree of severity. Finally, the results were corroborated with historical data from existing documents written in the same period in which the cemetery was functioning. This multidisciplinary approach, combining methods and data from physical anthropology, paleopathology, physics, and ethnographic and historical archives, allowed us to create a new image of the population inhabiting the town of Gheorgheni and assess their life-quality levels.

This study was funded in the frame of PCCA_1153/2011_P1 project.

Keywords: paleopathology, demography, bioarchaeology, Romania

P. RAJIĆ ŠIKANJIĆ | D. LOŽNJAK DIZDAR, Croatia

Creating the database of Urnfield burials from northern Croatia

Knowledge about prehistoric societies comes mostly from archaeological correlates of prehistoric mortuary practices. Formal cemeteries, consisting of individual graves, appear in Europe by the

beginning of the Bronze Age. Among the most prominent of them are the Urnfield cemeteries of the Central European Late Bronze Age. The systematic analysis of Urnfield burials from Croatia has rarely been conducted, especially regarding the anthropological analysis. Most of those analyses are limited to sex and age determination, lacking a synthetic treatment of anthropological and archaeological information.

In order to expand our current knowledge of Late Bronze Age mortuary practices and society, we introduced an interdisciplinary project combining physical anthropology and archaeology.

It will integrate analyses of burial features and associated artifacts with analyses of cremated human remains from several Urnfield cemeteries in northern Croatia, dated between 13th and 9th century BC. A trial public-access database will be designed in order to archive the anthropological and archaeological data, as well as to distribute and promote our findings. The database will be designed to archive data, in various digital formats, including field records, raw archaeological and anthropological data generated in the laboratory, and results of post-excavation analyses. Its immediate purpose is to make the data readily available for analysis and to provide a standardized framework within which analyses will be undertaken. The aim is to provide a public resource that can be modified and expanded to include information from other Urnfield cemeteries, thus allowing comparative studies and analyses of larger samples from the wider geographic region of the southern Carpathian Basin.

Keywords: Urnfield burials, Croatia, database

B. RIDDERHOF, The Netherlands

Custer and the Battle of Little Bighorn, American iconography versus archaeology

In June 1876 George Armstrong Custer and the 7th cavalry fought a heroic last stand at the battle of the little Bighorn against overwhelming forces of Sioux and Cheyenne Indians.   Best visualized in the movie "They died with their boots on" in which Errol Flynn played the heroic Custer last to fall with his saber in his hand, the general is presented as the quintessential whitonian hero as described in the poem "Leaves of Grass.

Since then many volumes of research have been written about the battle and about Custer (about 900 volumes), but they all limit themselves to a repetition (with small variations) of the first description in 1876 by F. Whittaker. The only variable is weather Custer is the villain and the Native Americans the victims or whether Custer is the victim of ruthless politicians. Custer and the battle survive as an iconographical picture of the American west.

The main reason for this is the American law which prohibited excavations at the burial site. Only 108 years after the battle the first excavation was carried out at the site of the battle. By then the traditional idea of Custer's Last stand has been ingrained in the American psyche. And although two more excavations indicated a different picture of the battle "the picture of the last stand endures until this day.

This presentation draws on all the material to present what really happened. Using history, forensic archaeology and the excavation reports it will show that the battle was not a battle but hardly a skirmish which lasted only 5 to 7 minutes.

Keywords: Battlefield archaeology, history, forensics, burials

G. SOETERS, The Netherlands

"They shoot horses, don't they?"

Maastricht is a city in the south of the Netherlands that was often besieged by Spaniards, French or Dutch troops from the 15th till 18th century. Every now and then some relicts of those sieges are found during archaeological excavations. In 2010 a large excavation took place directly north of the city of Maastricht in Borgharen. The main focus was on Iron Age settlements, Early Medieval graves and a Roman villa landscape. But ditches from later periods were also found and in one of them 65 horses were buried, side by side and on top of each other. The ditch in zigzag-shape looks like a so called "circumvallation" or a ditch to protect besiegers from rescue troops from the besieged. The find was well excavated and gained a lot of interest from the media: over a thousand visitors in one day, primetime news on the TV, an article in the Washington Post and in international "equestrian" magazines. And even after the scientific rapport was published the horses generated a lot of commotion in the world of local historians and archaeologists. There were debates about the exact dating and what kind of horses these were. And there is a public demand to commemorate this extraordinary find and the public is putting a lot of pressure on local politicians.

So the questions that are to be answered are: can the horses be dated exactly? How did the horses die? Where they French chevaux, Spanish caballos, German Pferde, Scottish horses or Dutch knollen? Did they belong to the cavalry or did they pull canons or carriages? And how do you present such a large find in a proper way to the public nowadays?

Keywords: Sieges, mass-grave, horses

I. TIMPERMAN, UK

Early Niche Graves in the Turfan Basin (c. 300 BCE–300 CE): A Critical Approach to Data Mining

This research analyses mortuary variability in the Turfan Basin (Xinjiang, P.R. China) to understand the motivation for using niche graves in this area. The strength of the methodology is the bottom-up approach to data mining. The data are collected and fed into a mySQL database at the lowest possible level, so that these basic analytical units can be aggregated at any moment to the level needed. This will make it possible to look at the data from multiple perspectives, views or paradigms. Ultimately, this case study illustrates how quantitative or statistical approaches can be used to enhance a critical attitude towards data collection, data mining and data analysis.

This methodology will allow a combination of deductive and (true) inductive reasoning: pre-defined questions can be addressed and new ones can be generated. Three main pre-defined questions are: 1) Do the early niche graves in the Turfan Basin represent an innovation introduced by immigrants, or are they rather the result of a local development in tomb architecture? 2) What motivated the use of niche graves in the Turfan Basin? 3) If the niche graves in the Turfan Basin represent a type introduced from outside, how can they be linked to similar practices in other regions? The ultimate question is whether the research category 'niche grave' is significant at all?

It is my ambition that this research will serve as a data mining model for future research in this area that will make it possible to 1) standardise the collection of 'big data'; 2) simplify comparative intrasite

and intersite analysis, and finally 3) generate new research questions while maintaining a critical attitude towards the data.

Keywords: Data mining, mortuary analysis, Turfan

J. P. ZEITLER, Germany

Crisscross orientation in a late medieval and early modern cemetery in Nürnberg: facts and interpretations

During the excavation of a drainage pipe east of the Chapel of "St. Peter and Paul im Siechgraben", a late medieval infirmary chapel 2 km southeast of the city walls of Nürnberg, 32 inhumations could be uncovered in situ. Remains of at least 19 more were found disturbed by later burials or recent building activity on the site. The radiocarbon dates ranging from 1387 – 1651 confirmed the historical records of the cemetery, stretching from 1389 to the late 18th century. Surprisingly, only 14 = 45 % of the burials showed the regular east-west orientation of medieval and early modern inhumations. Another 4 were orientated west-east, i.e. with the head in the east, while 7 burials showed a north-south and 5 burials a south-north orientation. Adding identifiable dislocated long bones, the ratio of east-west to north-south orientated burials were approximately 50 : 50. This argues strongly against the common interpretation of north-south orientation as an indicator for unchristian burials. Stratigraphically, the east-west burials usually overlaid the north-south orientated burials, arguing for two main phases of the cemetery. Moreover, the layout of the burials showed a distinct difference. While the east-west orientated inhumations were spread irregular over the area, the north-south orientated burials were lowered in parallel alignments, with burials overlying lengthwise. Anthropological and palaeodontological analysis showed further differences between the two main groups, leading to a historically based interpretation model of the unusual change of orientation.

Keywords: Burial orientation, infirmary, historical data

Session: UAV4urban_archaeology: Recording archaeological sites and monuments with UAVs (Chairs: Marco BLOCK-BERLITZ | Benjamin DUCKE, Germany / Peter DORNINGER | Christian BRIESE, Austria)

The degrees of freedom in archaeological data processing, analysis and interpretation are physically constrained by the limited number of perspectives that archaeologists can have on their sites. Recently, unmanned Aerial Vehicles (UAVs) have evolved to allow capturing data from previously impossible view-points and at high resolution.

This session is dedicated to a fast growing technology trend in archaeology: UAVs equipped with digital sensors for the documentation of heritage sites and monuments from above. The increasing power and ease-of-operation of UAVs, ranging from off-the-shelves consumer devices to highly specialised solutions, make them ever more versatile carrier systems for a range of digital sensors. In the most straight-forward case, airborne cameras can be used to produce classic photogrammetry products, such as high-resolution terrain models and ortho-rectified images. But other options, such as infrared imaging or even airborne laser scanning, are also possible..

But at the same time, the technological challenges are as manifold as the possibilities. Limited energy supplies put tough constraints on payload and reach, as do the computational demands of methods such as Structure from Motion (SfM) for 3D reconstruction. These challenges call for optimised recording and data processing strategies as much as for technological improvements.

Currently, the legislative authorities of many countries worldwide specify legal frameworks for UAV technology. Contributions related to legal issues are therefore also welcome, as are great ideas for future applications, even if they might not yet be possible to realize, due to legal or technological restrictions.

We invite contributions that explore these and other applications and aspects of UAV technology in archaeology and cultural heritage management.

M. BLOCK-BERLITZ | B. DUCKE, Germany

My drone is cheaper than yours: the possibilites of UAVs and image-based 3D reconstruction using consumer grade hardware

The use of UAVs and image-based processing in archaeology shows signs of a technology in transition. At this stage, we can differentiate between a traditional "photogrammetric" approach that favours expensive camera systems, calibrated lenses and high resolution, high quality imagery, and a radically new "computer vision" approach that attempts to make the most of consumer grade hardware, massive input data and highly efficient, often GPU-based software. Both approaches deserve to be explored for their individual strengths and weaknesses.

This Paper focuses on the "quantity beats quality" approach, presenting a range of case studies where cheap and sturdy UAVs equipped with equally cheap and robust camera systems, using distorted but efficient fish-eye lenses, have been put to the test in diverse, sometimes extreme environments. We present advances in using highly automated processing methods to generate detailed 3D models and derivative products such as terrain models and orthophotos from regular HD video streams instead of high resolution single shots.

Constant progress in computer vision algorithms means that we can get ever more out of our data, and our case studies will demonstrate why we think that money is better spent on lots of cheap consumer hardware then on a few expensive systems. The cheaper the devices, the more obvious the discrepancy between the necessary investments for hardware and software licenses. Therefore, we will showcase the kind of results that archaeologists can expect from software that is available at no cost, be it as freeware or open source software.

Keywords: UAV, SfM, 3D recording, low-cost

Ch. BRIESE | M. PFENNIGBAUER | M. DONEUS | A. ULLRICH, Austria

Radiometric Information from UAS-Borne Close Range Lidar

Airborne laser scanning (ALS) is an active remote sensing technique that is typically used for the acquisition of large landscapes. The resulting three-dimensional point cloud is utilized for a lot of different application areas. Since several years, ALS is also widely used in archaeological prospection. Next to the typically used geometric information, recent publications demonstrate the possibility and first investigations for the practical applicability of calibrated radiometric information from ALS data.

Next to ALS sensors designed for different application areas, light weight ALS sensors for unmanned aerial systems (UAS) became available just recently. This contribution focuses on the radiometric calibration of a data acquired with a new UAS-borne single-wavelength close range ALS sensor, the RIEGL VUX-1. The sensor was tested onboard a standard helicopter on the study site Carnuntum, Austria as there was no adequate UAS System available at the time of data acquisition. After acquisition, the ALS data was radiometrically calibrated with the help of the software OPALS. Subsequently, calibrated reflectance maps at the laser wavelength of 1550 nm are available. These maps can be used in order to study the present archaeological features. Compared to standard passive images these maps are not influenced by the actual illumination by sun light, i.e. there are no shadows, due to the active laser illumination. Additional, the absolute radiometric calibration allows to analyse multi-temporal ALS datasets of the same laser wavelength. Furthermore, the resulting calibrated reflectivity maps at a wavelength of 1550nm might be an interesting reference for the radiometric calibration of airborne passive image spectroscopy data. Finally, a summary and an outlook to future research work conclude the contribution.

Keywords: Radiometric calibration, UAV, UAS, airborne laser scanning, lidar

P. DORNINGER | D. KRAWCZYK | C. NOTHEGGER, Austria

Scan-Copter – UAV-Based High-Resolution LiDAR

Supported by the ongoing development of structure from motion based 3D modeling approaches, UAVs equipped with camera systems emerged as effective platforms for 3D data acquisition of cultural heritage objects. UAVs enable close range top shots of tall objects or objects at elevated positions which were so far not accessible in a comparable manner, thus bridging the gap between high-resolution terrestrial applications and low-resolution airborne approaches based on airplanes or helicopters. While image based object reconstruction implicitly provides texture information for 3D visualization and interpretation, laserscanning in general excels with respect to the achievable accuracy and richness in detail. This applies in particular to highly structured objects, if little texture information is available or under insufficient lighting conditions. So far, however, high-resolution laserscanning was restricted to either be applied from terrestrial scanning positions or from manned aircrafts with a minimum distance of some hundred meters above the object of interest. Scan-Copter enables for the first time the UAV based application of a conventional terrestrial phase-shift laserscanner, i.e. the FARO Focus series. By means of highly accurate positioning systems and optionally supported by ground based tracking, the achievable accuracy and resolution of the thus acquired objects are close to 1 cm. For large scale applications with some hundred meters of extension, about 5 cm accuracy are achievable. In addition, the system can also be used with Riegl's UAV-scanner VUX-1. Based on its wave-form-analysis measurement principle, this system allows penetrating vegetation as known from Riegl's airborne LiDAR systems, but with a locally higher resolution and accuracy. By integrating conventional terrestrial laserscans with point-clouds acquired by the Scan-Copter, a homogeneous representation of objects is enabled while minimizing the occurrence of occluded areas. Thus, subsequent processing and interpretation of such data-set is significantly improved.

Keywords: Laserscanning, 3D modeling, visualization, accuracy

T. SCHIEMANK | B. GEHMLICH | M. BLOCK-BERLITZ, Germany

The autonomous, flying archaeologists of the future

Service providers such as Amazon and DHL have been announcing their intentions of deploying autonomous drones for goods delivery. Rapid progress in robotics and sensor data processing has incited vehicle manufacturers to develop and bring to market an increasing number of assistive systems. The promise behind such technology is that computers will be able to take the burden of having to operate and navigate vehicles from human pilots.

The implications for archaeology are clear: Autonomous (or semi-autonomous) UAVs would be able to record large sites efficiently, with minimal human intervention. This would allow not only one-time recordings, but also continuous monitoring of sites at minimal cost.

But how well does today's cutting edge technology really work, and, most importantly for us, can we adapt it to produce autonomous systems in archaeology? What are the real world limitations of this approach? What additional planning tools and safety measures are necessary when using autonomous UAVs for archaeological prospection and site recording?

This paper will give an overview of current technologies and discuss the development process for a semi-autonomous UAV within the archaeocopter.de framework. We will present the results of recent aerial prospections and technologies that have the potential of becoming part of archaeology's standard toolkit for site recording in the near future.

Keywords: Autonomous systems, UAVs, 3D site recording, archaeology

Ch. SCHUBERT, Germany

Multicopters – an everyday documentation tool for archaeologists?

In recent years, the use of multicopters as sensor platforms for the documentation of archaeological monuments and excavations has become quite popular. With a digital camera mounted, they can provide image data for overviews or further processing using SfM (Structure from Motion) software. Nevertheless, until now, only a small number of specialists really use multicopters. Sophisticated copters are either expensive to buy or can only be build by yourself with specific knowledge and skills. Since the release of DJIs "Phantom", a relatively cheap, easy to operate and astoundingly robust quadrocopter has been available. Equipped with a so called actioncam, an "off-the-shelf" system has been tested by the Saxony Archaeological Heritage Office in cooperation with the archaeocopter-project (www.archaeocopter.de). The obtained image data was then processed to 3D-models and orthographic images.

The presented examples range from medieval excavations with complex three dimensional structures to larger areas containing prehistoric features. An overview of the possibilities and limitations of the used hardware will be given as well as the requirements imposed on the operator and a short introduction to legal restrictions.

Keywords: Low-cost UAV, quadrocopter, Structure from Motion

One important aspect of the conference „Cultural Heritage and New Technologies" is that it brings together students, young scientists and experts and in that way enables and promotes an exchange of ideas. While the conference turned out to be a home for informal talks and exchange of ideas, it still lacks presentations from the young scientific generation.

Due to the success of the "Newbie-Workshop" at last year's meeting, we are encouraged to proceed and to offer a similar format for 2014. The session wants to encourage especially young scientists to present for their first time at a conference. The topic of the presentation should be within the scope of the conference. New ideas, new ways of thinking, clever solutions, workarounds, or critical thoughts are especially welcome.The conference organizers agreed that every presenter will get free admission to the conference.

J. BRUSCHKE | M. WACKER, Germany

A new digital documentation tool for the 3D-reconstruction process

Nowadays, digital reconstructions are becoming more and more common in archaeology and architecture. They visualize lost, but also present structures, can broaden the comprehension of the reconstructed object and point out historical and constructional relationships. Furthermore the process of reconstruction leads to an aggregation of knowledge and has become a substantial part of scientific work.

However, such projects usually lack of a proper, traceable, and valuable documentation practice. In the final reconstruction state the reference of a source for a certain object may only been known to experts in the project. Understanding from an external point of view often becomes a cumbersome process. Most research for documentation practice is concentrated to theoretical approaches; valuable practical tools are still missing.

We introduce a documentation tool for 3d reconstruction supposed to accompany a project and to support frequent tasks in digital reconstruction processes. All used sources can be (easily) inserted into the system and connected to the reconstructed objects. Simultaneously, the whole development process is logged automatically. The data is stored compliant to the CIDOC-CRM in a graph database, which matches the structure of an ontology and is designed for highly connected data. With suitable navigation functionality the user can explore/compare the 3d-model together with the sources and information. Furthermore there is a special mode for briefings: comments of the participating users can be logged and sketches can be drawn on the model or plans which will be available for the following modelling process. Version control ensures that edited objects are synchronised with the database to record all development steps and to be able to access older versions of the model. This tool not only may help enormously during the reconstruction process but also can be applied for final presentation of the results to experts or e.g. museum visitors.

Keywords: Documentation, 3D-reconstruction, data exploration, graph database, version control

A. MANCUSO | A. PASQUALI, Italy

Different ways lead to different results? Experiences on modern photogrammetric surveying of Cultural Heritage subjects

The aim of our research is to analyze three-dimensional models obtained by processing different survey data, to compare the specific workflows in terms of data gathering speed, performance and processing efficiency, errors and their mitigation methods in final digital models.

The results will be achieved by a comparison between 3D digital models, generated by photogrammetry based on specific set of pictures, but the firsts from a Direct Survey Campaign (DSC) and the second from the Web: the variable of the research is the difference of the data underlying the processes.

The DSC is executed in situ, in a short time, performed by a single operator with a tripod, so the resulting images are uniform for coloring and lighting.

The Web Archive Survey Campaign (WASC) consists in a selection of web images, with the experience of the test developed in October 2011 by the University of Washington, called "Building Rome in a Day". The result is characterized by many differences of the shots collected: various photographic equipments, light conditions, exposure, web compression alterations, but also many points of view.

After a careful verification of data usability, the two groups of images are processed in dedicated softwares; then the calculation is finalized in a set of 3D-models with texture mapping.

The final surface mesh will be subjected to comparative tests between the other models.

The results obtained will contain the conclusions about the degree of reliability of WASC in front of the complete and exhaustive DSC methods, evaluating perceptual appearance, by image rendering processes, as well as through the reliability of the geometric return on errors observation.

All the case studies will be aimed to Cultural Heritage subjects, analyzed in their specific contests and capable to give a clear reference scenario of these important solutions for quick and well working digital survey.

Keywords: Photogrammetry, survey, comparison, processing, web resources

L. MISZK, Poland

Forming 3D Database for Classical Sites on the Example of Nea Paphos (Cyprus)

Methodology

The main purpose of this study is to present the foundations of forming new documentation standards for the Nea Paphos, Cyprus site.

The main goal of the works that are the topic of this presentation was to create a complete database in a GIS environment as a base for 3D database map. The first step in the development of the database was to prepare digital terrain models (DTM) for the aforementioned sites, using a 3D scanner together with Microstation and Micromap software. The models will be supplemented by applying calibrated photogrammetric documentation of registered architectural structures and trench profiles. It will result in a three-dimensional site model with the possibility of further developing each of its individual components.

Results: The three-dimensional site model will serve as a basis for a multilayer orthophotomap, which

will also include aerial photographs and geophysical maps, as well as archival photos and maps. The whole project, developed in a GIS environment, will be supplemented with information on the archaeological material collected during the excavations, i.e. its location, illustration, photograph, chronology, etc. As mentioned above, it will result in a complete database functioning in one system with the access to all the information about the site, its architecture and full documentation for both field and lab use.

Innovations: This type of holistic approach to create databases on the classic sites on Cyprus has not been used so far. We want to show the possibilities and facilities of using this type of solutions. Also an important aspect will be to present the logistical arrangements made for implementation these tasks which have to be done.

Keywords: Database, DTM, Photogrammetry

K. ROSIŃSKA-BALIK, Poland

From Sketch to Virtual Reality. The Case Study of Ancient Brewery from Tell el-Farkha, Egypt

Methods and techniques of field work documentation are constantly being improved. In the era of visual media, it has become necessary to upgrade traditional drawings and records of structures unearthed during archaeological prospection. Documentation process of excavated sites has always been crucial especially when a considered feature, accordingly to specific destructive character of archaeological examination, is accessible to researchers for limited time. Parallel to graphic and visual improvement go possibilities of data interpretation. The new way of view produces not only eye-catching images but it could be a great resource for further consideration, testing hypotheses or research result presentation.

In my paper I would like to present development in documentation techniques implemented during over 15 years of excavation at the Tell el-Farkha site in Egypt. This Pre- and Early Dynastic site gives great opportunities since different types of features are registered on it starting from domestic structures at a settlement area, through industrial installations and ending on graves. I would like to focus on some specific structures discovered over the time – breweries. Several examples of these devices were recorded at the site and during the passing years they were documented in various styles (from traditional drawings, virtual reconstruction to 3D documentation). The goal of my paper is to present them all with all their pros and cons.

Keywords: Documentation, 3D reality, virtual reconstruction, archaeological tools

N. M. SHOUKRY, Egypt

Documentation and Preservation of historical Cairo Cultural Heritage and its relation to urban tourism through the use of New Technologies

Urban tourism is a type of tourism, known and practiced for a long time in various countries around the world but rarely in Egypt. This kind of tourism generally rebounds after economic and political crises the thing that allows countries to take the opportunity to reactivate their economies.

View the current economic difficulties in Egypt, solutions affecting the daily lives of Egyptians had to be found while protecting the cultural heritage patrimony of Cairo. In other words, it is about encouraging tourists to visit the city by organizing special touristic programs for the city. This cannot

be achieved without the documentation of the patrimony; it must include the events that took place in the chosen area as well as people who lived there.

But this kind of tourism cannot be developed through normal touristic process of travel agencies as it is not applicable to mass tourism. On the contrary, it can only be achieved through individual electronic programs whereby tourists would have access to mobile applications supplied by GIS maps where all or part of the information is already uploaded. New technologies will then play a double role of preserving cultural heritage and regenerating economy which leads to sustainable development of the chosen area.

This article aims to show how urban tourism in Egypt can be generated while using the new technologies for documenting and preserving the national patrimony. The article discusses the undeveloped area of Historical Cairo that risks, nowadays, to be moved off the list of the International Patrimony List of the UNESCO if not documented and developed.

Keywords: Urban, archaeology, cultural heritage, tourism, GIS maps, Mobile Applications

D. VAN DOKKUM | B. RIDDERHOF, The Netherlands

Italian city-states a data warehouse for the true story of sex, murder and mayhem in 15th century Italy

15th century city-state Italy is booming in the 21st century thanks to television programs like The Borgia's and Da Vincis Demons. The audience is being dazzle by larger than life characters, 3d reconstructions and the implication that all is based on historical facts.

However when we look at the amount of data available from this period and the interconnectivity between the different strands of data (i.e. paintings, royal families, the city states, one is left with a lacuna. NO data warehouse exits in which one can lay a connection between a spawn of the ruling families (like Catharina Sforza) and the relationship with other families, ownership of cities and lands beyond, astrology and espionage etc.

Two years ago the students from the VU-University Amsterdam started under the tutelage of B. Ridderhof on the project to firstly design and develop and data warehouse for the city-states of 15th century Italy and to collect relevant basic data. From the start all the relevant data had to share Interconnectivity with all other basic data collected. Now the first results will be presented.

Using two paintings (one of which is a portrait of Catharina Sforza) This presentation will show how the different type of data are connected and that it will be possible to enter the finished data warehouse from multiple angles for research date.

Keywords: Interconnectivity, data warehouse Italian city-states

R. WESSLING, Austria

Large- scale high-resolution landscape modelling of coastal areas with Kite Aerial Photography

Kites are widespread camera platforms for low cost aerial imagery and are mainly used for intra-site recordings. In this study Kite Aerial Photography was used to map large-scale archaeological landscapes covering an area up to 50 hectares to create seamless areas between the sites and to put the sites in a wider spatial context. For this purpose Image Based Modelling techniques (Structure from Motion and Multi View Stereo) are applied to create high-resolution topographic datasets of

coastal areas in the North Atlantic. On the basis of different case studies, located in Norway, Shetland, Faroe Islands and Greenland, the possibilities but also the limitations of this method are illustrated. It also shows which approaches have been chosen to adapt to the diverse landscapes in terms of wind and light conditions, vegetation, barriers and obstacles. The generated digital surface models serve as compensation for lacking ALS-data for general mapping, landscape visualisation and spatial analysis, as well as for inspection of relief details and modelling of geomorphological changes. Selected examples demonstrate how to interpret the computed 3D-models critically, e.g. how to recognise artefacts that are caused due to insufficient overlap. The study will also try to focus on the individual perception of the landscape that is reflected from walking with the kite systematically trough and by orienting oneself in the scenery from a phenomenological point of view.

Keywords: Kite Aerial Photography, Structure from Motion, large-scale landscape modelling, phenomenology

G. ANZANI | F. ALGOSTINO | E. CECCONI | F. TIOLI, Italy

Digital 3D print and reverse engineering for Cultural Heritage, the experience of the LMA (Architectural Modelling Laboratory) of the Didalabs system in Florence

In February 2014 the Architectural Modelling Laboratory at the "Dipartimento di Architettura" in Florence has started its public activities. As a part of the Didalabs (the Laboratory System of the Department) it has offered support, innovation and knowhow to all the students and scholars of the florentine Athenaeum. It has gathered a long tradition of surveying, modelling, architecture design and research for innovation to build a collaborative and well working approach to support research and learning. During its first year of activities many Cultural Heritage subjects has been digitalized, studied, brought to be complete digital models and then 3D printed into scaled physical models. This continuos and challenging work has created the bases to develop specific and consolidated methods, well working practices, and sometimes some rethinking about certain digital solutions. The parallel between research and teaching support has created the need to consolidate a fully digital approach to the cultural heritage documentation, with a very practical approach, always oriented to get the best result with the minimal effort out of the most recent and interesting digital techniques. In the poster presented here it will be described the solution adopted in some important works, the testing of specific balance between digital and real, the benchmark of different 3D digital printing systems according to their use in the field of cultural heritage. The results, suggestions, solved issues, will be described to bring an useful contribution to the discussion about the best practices in digital heritage procedures, with a wide range of case studies from the historical objects, to the statues, to the large architectural artifacts.
Keywords: 3D Laser Scanner, Florence, 3D Printing, Didalabs, 3D modeling

G. CERRI | F. CORSINI, Italy

Digital reconstruction and analysis of the Nari's monument in Florence, a Bartolomeo Ammannati's statue from the St. Annunziata church to the Bargello national museum

Some monuments cross time and arrive to our age with almost the same quality of their original time, but they are just a bounce of few samples. The most of the ancient artifacts cross time with various alterations and transformation. The sepulchral statue of Mario Nari, composed by a laying warrior and an allegory of Victory dominating a fallen prisoner, can tell a story of unlucky events that have demolished the original elements from their original setup, and brought it in pieces at the Bargello national museum in Florence. This white marble couple of statues was made by Bartolomeo Ammannati, architect and sculptor, from the 1539 to the 1542. The tomb has suffered the prohibition of being exposed while it was in the St. Annunziata church and later it was crashed by vandals and risked the total destruction. The two surviving statues, has been the object of a new setup in occasion of the celebrations of the five centuries from the Ammannati's birth and were recomposed to fit the most similar condition to their original aspect. The 3D digital survey and a further photogrammetric

survey have created the right documentation and models to start hypothesizing the original composition. The 3D digital survey of the bay of the church for which the statue was originally designed allowed the perfect condition to verify the new hypothesis about this interesting and well designed monument. The digital 3D model treated inside CAD tools has been the perfect tool to analyze in detail all the possible solutions and mix together the aspects of the historical investigation with the understanding of the design rules behind this masterpiece. This poster will summarize the structure of the research done to understand and re-read this late Renaissance statue and will present the results of its virtual reconstruction.

Keywords: 3D Laser Scanner, Florence, Bartolomeo Ammannati, statue, sepulcher

P. FORMAGLINI | F. GIANSANTI, Italy

The "Banuelo" at the ancient entrance of Granada, survey and analysis in a fully digital approach

As the meaning of spas in the classical period, the public baths were a reference point for social life in the Medieval Islamic culture, where the relation between Muslim citizens and water was a very important aspect. In addition to the hygienic aspect, the water had also two strong symbolic values: the first, in "sure" which referred to a paradisiac premium; the second was for its purifying value as an important part of rites of ablution required before praying. The result is that public baths become an important urban element and they can reveal ancient traces about the urban context.

The Hamman of Granada, called "Banuelo", is one of the most representative because of many factors: its good state of preservation and its considerable size allow well to take the suggestion that its plan fits in a perfect rectangle.

The aim of the study presented here is to compare, starting and exploiting the digital survey techniques, the conformity of this Hamman with the known case studies of the baths and to focus on the urban-environmental relations in this area.

These aspects are very important for the purposes of this research: the presence of an archetypal and so great bath, confirms that the typical model, with the entrance not in line with the main road, is certainly indicative of the presence of an important street, slightly away from the current one (Carrera del Darro).

Considering the distribution of this Hamman in the city, the lack of mosques in the area, the proximity of to the city walls and the size of the bath, it is plausible to hypothesize the presence of a single complex with its own city door. This study will present a specific hypothesis about the ancient shape and organization of Granada in this part of the town.

Keywords: Survey, Granada, Banuelo, bath, urban-environmental relations

G. Di GIACOMO | G. SCARDOZZI, Italy

A GIScloud system for the knowledge and data sharing and management: Urban Archaeology and Smart City solutions for Culture and Turism in Lecce (Apulia, Italy)

The paper concerns an experimental system for the management of data related to cultural heritage (in particular archaeological) of the urban area of Lecce, developed by IBAM CNR within the project "DICET Smart Cities and Communities Social Innovation". The system, based on the Cloud

technology (SaaS), embeds in a dashboard, accessible from the web, some applications for the consultation of the archaeological map of Lecce and for the management of an eterogeneous dataset of ancient evidences of the Messapian, Roman and Medieval times, many of which are now "invisible" because of the obliteration by modern structures. The historic center of the city is a multilayered context, with a continuity of life since Proto-historic age until to Renaissance, Baroque and Modern times. The system manages also raster time-slices from GPR prospecting carried out in various contexts, offering the ability to read 3D subsurface anomalies at depths between 3 and 6 m.

The system is based on a suite of open source softwares modified according to the project purposes. The result is a web portal that, depending on the credentials of the users during login, offers an area for consultation/inserting/modifying alphanumeric and geospatial data and an area for consultation only.

This portal allows researchers and Public Administrations technicians to manage data, while other users (citizens, scholars, tourists) are able to query the data only. The GIScloud is an user friendly platform, but suitable for managing complex data across standardized procedures and optimized for fast and efficient data sharing over the web; this "smart tool" contains all the GIS features to the study of ancient evidence and offers all the opportunities of cloud systems for data sharing among research agencies and those dealing with the protection and management of cultural heritage, and also those dealing with urban planning.

Keywords: GIS, Cloud, cartography, urban archaeology, data sharing, management

I. HERZOG, Germany | A. YÉPEZ , Ecuador

Analyzing Patterns of Movement and of settlement in the East-Andean Mountains of Ecuador

The Quijos and Cosanga study area is located in the East Andean mountains in Ecuador. This area is probably the origin of the Cosanga pottery which has also been recorded in the late cultures of the Andes in northern Ecuador. The trade of pottery in prehispanic time is one of the reasons for studying this area in terms of movement patterns. Based on the assumption that the ancient movement patterns are preserved in old paths, least-cost path analysis is used to identify the main friction factors. Four old paths are considered, and it seems that slope and crossing streams are important friction factors, though the match of the known routes and the least-cost path reconstructions is not perfect in most cases. Based on the model describing the movement patterns, the routes between known ancient path segments are reconstructed. Moreover, least-cost site catchments are generated for seven Late Period settlements recorded in a survey project directed by Andrea Cuéllar in 2002. According to Cuéllar, three of these settlements are small, two are moderately nucleated and two are large nucleated. The catchment sizes and the settlement sizes do not correlate, suggesting that other aspects beyond subsistence played an important role for choosing a settlement location. Viewshed calculations show that two of the nucleated Late Period settlements could have exercised visual control over the old routes.

Keywords: Least-cost paths, site catchments, viewsheds, East Andean Mountains

M. JAHANGARDI | N. H. MOGHADDAS | O. GRAZHIAN, Iran

Ground Penetrating Radar Prospection at Tepe Damghani, Iran

The pre historical site Tepe Damghani of Sabzevar is located at NE of Iran in Khorasan- E- Razavi province. This 110 hactares vast site is the cultural index of Bronze Age in Great Khorasan that consists of various periods from the third Millennium BC to the dawn of history.

For rescuing this site located at Sabzevar modern city, so far three excavation seasons has been carried out with stratigraphy and site boarders determination. For increasing the speed of rescuing process of vast site carried out Ground Penetrating radar (GPR) studies with 250MHz antenna for the first time in three separated parts of this site which confirmed previous archaeological findings and resulted in discovering cultural layers and structures and in addition to that, the boundary between cultural and natural layers was recognized.

Keywords: GPR, Tepe Damghani, Bronze Age, geomorphology

M. L. KING | C. M. BECK, USA

The Archaeology of Atmospheric Nuclear Test Sites

In the United States, the archaeological study of atmospheric nuclear testing remains at the Nevada National Security Site began in 1991. The initial archaeological research identified, recorded, and documented extant nuclear testing material culture at specific locations on the landscape. This work was spatially limited and could only provide a narrow view of the historic context. As the years passed, the archaeologists' understanding of nuclear testing increased, contributing to the recognition of larger test landscapes and historic districts. This process primarily focused on the visible post-test remains in a limited area. Eventually, this view was extended to encompass buildings and structures, distant from the actual test ground zero, but integral to the testing program, such as bunkers that housed remote instrumentation and trenches for military troops. This was achieved through the incorporation of information in historic documents, engineering plans, and archival photographs, which included pre-test planning, construction, and other activities that could be compared to the post-test remains. Working with recent aerial and terrestrial radiological survey data at several test locations, the fundamental material culture research has been broadened to incorporate the associated radiological plume, an invisible but detectable landscape feature. This approach brings an added dimension to the archaeology of atmospheric nuclear test sites by showing an aspect of nuclear testing not previously considered part of the material culture. This integrative methodology highlights the complexity of studying the unique aspects of nuclear testing sites.

Keywords: States, methodology

G. RAAB, Austria

Air prospection in Hamadab & Meroe (Northsudan)

The first full survey connected with the HMD-QSAP Project, started in September 2013, was carried out between January 14th and March 3rd 2014. The Work displays the first out of two plannedarchaeological survey-campaigns comprising a more or less comprehensive surface documentation related on archaeological remains of all subsumable periods in time up to modern or rather subrecent date.

The project is founded from Qatar (QSAP). The project director is Dr. Pawel Wolf (DAI). The leader of the survey team is Mag. Florian Wöss (DAI). My assignment was to help on the survey and to make aerial orthophotos and 3D models with the help of a low cost quadrocopter (DJI Phantom).

Research Area

In the frame of the QSAP we planned an archaeological reconnaissance survey in the research area between the Wadi el-Hawad in the south and Meroe City in the north, including the both banks of the Nile and parts of the desert and rocky terrains in the east.

The survey was carried out in two steps:

- a preliminary examination of the research area 14 November – 1 December 2013 with focus on known sites already documented by Fritz Hinkel
- a main survey 14 January – 3 March 2014

My task, in the project, was the documentation of selected sights all over the survey region. I used a DJI Phantom 1 combined with a Canon S100 and a Canon A2500 Camera to produce orthophotos and 3D Models of the landscape and the archaeological remains. In January I started a survey with the DAI Orientabteilung of Berlin in the Hamadab and Meroe Region of the Republic of Sudan. With my poster I want to present the results. I used SFM programs to build the models and photos. I tested several Canon cameras and used a KAP/UAV program for it. The innovations are first tests with a phantom in the desert and the management of incoming problems like sand and high temperature (sometimes 50°C in the sun). The poster shows not only the results of the modeling, it should help other people to know what they have to expect working with DJI UAVs in the desert.

Keywords: Quatrocopter, Low-Cost, 3D Modeling, Orthofoto

F. RAFANELLI, Italy

The complex of St. Daniel in Göreme, Cappadocia

The complex of the church of St Daniel, has been excavated in the same massif as Tokali Kilise, it is in itself a little known settlement, on which there are no major studies or assumptions. The complex consists of two pinnacles, one more than 40 meters high and a second lower one. At the base of the highest peak there are various secondary rooms, with multiple entrances, probably realized in time and intended for storing food reserves or other goods and even animal shelters. It is worth noting the presence of tunnels connecting such rooms with shelters at high altitude, the highest was to be occupied by a hermit's cell, a feature intended to facilitate the transit of persons to and from the warehouses or, more likely, to be interpreted as a defensive solution. The small size of these links in fact, prevented large numbers of people from passing through them; in addition, the shape of the tunnel itself made it necessary for invaders to proceed one at a time, creating a better chance of success for the monk in the event of an offensive. Nearby these locations there is a chapel dedicated to St Daniel. The presence of mural paintings in both the chapels, create a quite interesting condition where it is possible to see different decorative solutions, from the classical "red" paintings of the aniconic graphic to more rich and colorful representations. Such an articulated architecture, near to organic shapes, can be hardly described using traditional survey solution. The digital survey of the whole church, operated using 3D laser scanner technologies by a team from the "Dipartimento di Architettura di Firenze" in 2013, was the base to develop a specific reading of the whole church and

refuges system, and to create drawings to be used by visitors and scholars for easy understanding of the richness of this particular and very representative settlement.

Keywords: Cappadocia, Turkey, rupestrian, digital survey, representation

T. USAMI, Japan

GIS-based study of the distribution of jar-burials in the Middle Yayoi period in Northern Kyushu (Japan)

This presentation focuses on the study of jar-burials and grave goods in the Middle Yayoi period mainly in Fukuoka and Saga plains located in Northern Kyushu, Japan. Attempt will be made to explore the changes in their spatial distribution patterns employing Geographical Information System (GIS) and quantitative analysis techniques.

First of all, I will begin with a brief introduction about some of the important characteristics of the Yayoi Period in Japan, such as rice cultivation, mortuary practices, etc. After briefly summarizing the transformation of mortuary practices in Northern Kyushu, I will show the period wise distribution of jar-burials and grave goods based on my prepared database and several types of thematic maps. Then attempt will be made to demonstrate the local characteristics of the spatio-temporal patterns of jar-burials and grave goods adopting different techniques like multivariate statistics. At this point, I will also try to analyze the characteristics of settlement pattern changes within these two plains using the methods mentioned earlier. Finally, based on the findings of the exercises mentioned above, I will try to investigate the mutual relationship between these patterns. Notwithstanding the fact that there is lot of scope for improvement in this study, through this endeavor my focus will be on to interpret the changing relationship between the burial and residence and understand the social considerations taken during the Middle Yayoi period.

Keywords: GIS, Jar-burials, The Middle Yayoi Period, mortuary practices

G. VERDIANI | A. FRASCARI, Italy

The Mausoleums of the ancient Caria, guidelines for a digital approach

The destiny of some human artifacts seems to be to get lost and continues to live in the imagination of the masses. The tomb of Mausolo in Halicarnassus, one of the ancient world's wonders, can be indicated as one of the most important sample of this phenomenon, destroyed and almost disappeared; it still lives beyond its nature of being a tomb and exists as the symbol of an important lost heritage. The name of this kind of tombs comes from this specific building, but some recent discovery, like the tomb of Hekatomnos, the Mausolo's father, seems to pull the need for a rereading of the general knowledge about this kind of structures. The very specific conditions of these monuments can easily benefit from an extended and well managed digital approach, trying to combine together the new information coming from the new discovered sites, and the fragments coming from Halicarnassus and the Caria area and disseminated around various museums. A specific combination of 3D laser scanning, photogrammetry, 3D modeling can help to document and define a better knowledge about these architectures two millenniums and three centuries old. At the same time, this research can create the right conditions to share useful information between scholars. This poster is proposed as a summary for an ongoing research, still in the phase of data gathering. The workflow of

the research, some samples of the collected dataset, the aims and some first consideration about the Caria monuments will be presented to allow a first discussion about the new therms introduced by the discovery of the Hekatomnos tomb.

Keywords: 3D Laser Scanner, Caria, Mausolo, Hekatomnos, Mausoleum

H. ZEINER | S. RUSSEGGER, Austria

NFC – in the Use for Culture 2.0

After many years of intensive data collection and digitization of objects in cultural institutions, the age of presentation, data use and exploitation is now breaking on the data. Presentation not only in online catalogues but also data usage and exploitation by utilizing the latest technologies and opportunities, such as NFC and of course RFID (radio-frequency identification). Falling prices also in the field of NFC / RFID tags and the steadily spreading through smart phones with NFC support makes the use of this technology for smaller museums or archives interesting and affordable.

As partner in the funded project SECOS an application for smartphones is developed that enables cultural institutions to offer, for example, useful background information as APP in exhibitions. Under the leadership of JOANNEUM RESEARCH SECOS combines three leading international scientific groups and five global corporate partners to develop new applications with RFID / NFC technology e.g. in the cultural sector.

In the age of shrinking budget for culture, it is increasingly important that cultural institutions get more and more embedded in the public memory. Due to the increasing popularity of smartphones and the improving technology cultural institutions can bring themselves to the mind of visitors by offering "Apps".

This application is tailored to the needs of cultural institutions that want to provide a limited number of objects, for example at exhibitions with background information. By using the NFC technology of the visitor's smartphone background information that is e.g. too detailed for exhibitions is read by the App. The information on the mobile phone can be synchronized with the software on your smartphone or tablet and the corresponding cultural database. In addition, the APP also records additional information (eg, photos) and adds them to the specific objects.

Keywords: RFID, cultural App, presentation of background information

Category: Cultural Heritage
(Chair: Christian BRIESE, Austria)

M. I. ALMULLA, Qatar

A Narrative of Collecting and Interpreting Cultural Materials

E.H. Carr states that: 'In the first place, the facts of history never come to us 'pure', since they do not and cannot exist in a pure form: they are always reflected through the mind of the recorder'.
Obviously, interpretations of heritage and objects involve the personal and collective point of view of politicians and curators, which may influence the readings of these objects. Carr compares the influence of the author, in our case the curators, on the reader to fishing, where the author picks up the information he wants to present from various resources he might come across. As such, he states

that 'no document can tell us more than what the author of the document thought about what he thought had happened'. The question of historical facts may create a tension relationship between what the curators present, and the audiences as subjective readers. This is especially so if we analyse why objects that were collected and ordered in the 1970s are now being reordered and more objects collected, as this highlights that there is a renewed desire for the same objects to be presented as part of a different narrative.

For me, this fact raised an essential question: How far could we then consider the ordering of the objects and reconstruction of heritage in Qatar as representative of historical facts? Within my paper I analyze the narrative of collecting and objects' interpretations in Qatar.

Keywords: Objects interpretations, Qatar, museums, collections, heritage

A. ALIPERTA | C. GIRA, Italy

The Church of Meryem Ana in Göreme, Cappadocia. New life in prototyping and augmented reality

The submitted study case is about the rupestrian church of Meryem Ana in Göreme (Cappadocia, Turkey), a small church with mural paints representing valuable heritage at risk due to poor stability of the rock were it's excavated in.

In 2012 a team of researchers from DIDA – Dipartimento di Architettura, Università degli Studi di Firenze carried out a survey of the church that would show the artifact current conservation state and procedures to avoid the permanent loss.

The processing of data carried out by laser scanner and photographic survey made possible to produce conventional drawings and to build a 3D reality based model of the church thanks to reverse modelling, retopology and texturing techniques. This now represent an important database of a no longer accessible cultural heritage and a useful tool for still-images or animation products, but also an helpful mean for the development of research projects and restauration interventions for enhancement.

A scale model, build from 3D data with SLS technology (Selective Laser Sintering), and an augmented reality application, developed with Unity 3D and Vuforia are the way to achieve the main aim of the project, which is the recostruction of the church trough the integration of 3D print techniques and augmented reality technologies.

This applications properly programmed can be used for dissemination both in scientific and entertainment fields.

Keywords: Heritage at risk, reality based models, 3D Print, Augmented Reality

J. BARDI, Italy

Diagnosis of the theatrical Cultural Heritage in Florence

Considering the long established Florentine theatre tradition, stemming from the result of more than five centuries of history and the importance that theatre plays in the Florentine community, there has been a diagnosis of the inherited theatrical heritage in order to determine the state of its well-being and any possible solutions.

For the identification of the assets the following benchmark standards have been used: 1) for cultural heritage materials, the Italian Code of Cultural Heritage; 2) for the intangible cultural heritage,

UNESCO Convention for the Safeguarding of the Intangible Cultural Heritage.

The diagnosis showed, as expected, the presence of an enormous heritage that expects to be fully protected and enhanced.

There are 4 specific critical points:

1) The inexplicable and non-recognition of certain types of theatre equipment (by the local government), especially those that belong to the theatrical art handicraft production (sets and stagecraft material);

2) The cultural theatre heritage, such as, furniture and equipment, which is stored in libraries storages and archives. This creates dispersion and the historical heritages loses value thereby making an organic treatment impossible;

3) Several theatres, such as Teatro Comunale (born in 1862), the Arena Goldoni (born in 1818) and the National Theatre (founded in 1790) are in danger;

4) drawing attention to the intangible cultural heritage theatre, which is identified primarily in the tradition of opera, it's believed that the Maggio Musicale Fiorentino could be revived in some sectors (currently without storage rooms for scenes that are instead stored in the containers, and long tradition laboratories stage designs which are at risk of closure).

For those 4 critical points there are 4 possible solutions. The most important one is being able to create a single national museum of the theatre, which includes new laboratories, workshops-atelier and storage rooms for the Maggio Musicale Fiorentino. This would enhance the synthesis of theatre and all the "behind the scenes".

Keywords: Theatre, Cultural Heritage, Florence

H.-W. BARTZ | A. DEICKE | A. NEOVESKY, Germany

PBF Online – Digitizing the project "Prähistorische Bronzefunde"

Since 1966, the project „Prähistorische Bronzefunde" (PBF) has been collecting and publishing copper, bronze and iron finds dating from 3 000 to 500 BC and originating from the area of Middle Europe and its peripheral, mainly eastern regions. Culminating in more than 180 publications with over 140.000 objects and including countless figures and maps, any attempt at digitizing this wealth of data requires careful planning and the development of semi-automated workflows to process text and images.

PBF Online aims to provide comprehensive access to the unique material collected over almost 60 decades in the project "Prähistorische Bronzefunde" and a useful research tool for scholars of the Bronze and Iron Age all over the world.

As a first step, the text is digitized via double-keying. The resulting file is further structured with TUSTEP, a tool for rule-based text manipulation, which generates an XML-file to be imported into a MySQL-database. This database is the core of a web-frontend which enables the user to carry out comprehensive searches across all books, differentiating queries by categories such as place, type of find, context of find or associated finds. The website also contains information about the project itself as well as downloadable copies of the printed text.

Supporting the philosophy of OpenData, the data will be published under a Creative Commons-License. For this purpose all text and images will be available in standardized formats through a REST-interface.

A prototype presenting text and images of five books comprising of finds from the area of Lower Saxony will be available online shortly. Further data will be added successively.

Keywords: Online Edition, Bronze Age, find repository

L. BOMBARDIERI | A. M. JASINK | P. KRUKLIDIS, Italy

The Gallery and the Town: the Florentine Bronze Age Aegean and Cypriote Collections beyond the Museum walls

Bronze Age Aegean and Cypriote Collections are an important patrimony of the National Archaeological Museum of Florence, arising from old Museum donations, acquisitions and exchanges dating back to the end of the 1800-beginning of 1900. Several rearrangements of the location of these collections occurred, following the history of the Museum and the flood of 1966. As a consequence, many of the findings were conserved in the Museum storerooms and were not accessible to the visitors.

This project is addressed to a full recovery of the archaeological materials through a multiple approach. First step has been the complete systematic study of the material assemblages. As a second step, dedicated exhibitions of selected repertoires were organized in the Museum exhibition galleries and beyond them, in unconventional locations within the city of Florence. The positive feedback of these exhibitions raised up a new interest for the collections and paved the way toward further new initiatives. The traditional exhibitions have been flanked by the promotion of a virtual, interactive gallery (MUSINT) concerning objects not only kept in the Florentine Museum but also in other Tuscany Galleries, in order to offer a wider picture both for specialists and for general public. Along a virtual chronological, geographical and thematic itineraries, the visitor has the opportunity of different choices to explore sections and artefacts according to his own interest.

Both the traditional exhibitions and the interactive virtual gallery aim to 'open' and 'drive' the collections from the Museum storerooms to the Town. We believe that the proposed approaches can be easily extended to other collections to reinforce their informative value and enhance the attractive potentialities of our cultural archaeological patrimony.

Keywords: National Museum Florence, Aegean and Cypriote Archaeological Collections

R. CEBRIÁN JORGE | N. RUBIO CAMARILLO, Spain

Analysis of the distortion model of traditional architecture and its effect on Gran Canarias heritage

From the 60′, culture and architectural heritage are sometimes treated as a consumer object, trying to offer the tourist what is popular at that moment in that place. In addition, this popular movements are used also from the natives, referring to traditionalists models for themselves.

This often means that the heritage intervention (rural and urban) have been developed on request, often causing contradictions that change their the perception. Thus, sometimes, we approach to a wrong traditional architecture, as a hallmark of the city, as a brand of the village, as an object of merchandising.

By studying some cases located on the island of Gran Canaria, using visual and graphic analysis on various levels, we'll understand the importance of regulation and documentation of traditional models. In this way, the origin and meaning of the solutions adopted and inherited from other times becomes

apparent.

The purpose of this analysis is to reveal and links the origin and result of the passage from a functional architecture to an aesthetic architecture, that is been obtained by the interpretation of the first one, without any regulation invalidated by the municipal regulatory and island.

we will show different procedures of that fact and other different approaches to the built heritage, explaining what that means for the urban, rural architecture and in particular by the cave houses.

Keywords: Traditional architecture, rural heritage, traditional models

G. GANGL, Austria

Observational seismology on the 1895-Lubljana earthquake: Historical reports, "unstructured" data, macroseismic classification, and practical application

Franz E. Suess (1867-1941) was appointed as a young geologist by his employer the Imperial Geological Survey in Vienna to explore the Ljubljana earthquake of April 14, 1895, immediately after the earthquake event had taken place and to describe it in detail. Quite different from his father Eduard Suess, he used a pragmatic approach and laid down many significant observations. Based on the observations and in particular on the local damage degree, he plotted a "pleistoseismic map" with intensity data Points. Franz E. Suess is impressed by the damage in Ljubljana and in the surrounding villages. He recognized the influence of the loose substratum on the high damage caused.

Franz E Suess recognized already 1895 the relationship between the degree of damage and the kind of foundation soil of buildings. The event is included in the modern catalogue "CFTI4Med" Further contemporary publications are cited by ALBINI et al., 2014 as well as additional data points, where the earthquake was felt.

To classify the damage Franz E. Suess used one of the first macroseismic scales of Forel, a previous version of the later Rossi-Forel scale (1882) to characterize the local earthquake vibration. As a consequence of the damaging earthquake, an earthquake Commission was established by the Austria-Hungary monarchy, in which earthquake events were treated by officials in charge of each "crown land" (province of the monarchy).

The scientific assessment of historical earthquakes is essential for the earthquake research (risk evaluation). If we want to obtain information on the earthquake activity of past centuries; the immediate description of the past events is available, from the 1895 earthquake numerous photographs exist too (NUK 1995), allow to estimate the degree of damage and the intensity of the vibration by the latest macroseismic scale (European Macroseismic Scale <EMS98>), by which the maximal intensity of degree 9 was reached. The intensity should be distinguished from the magnitude value of an earthquake, which characterizes the energy of an event, calculated from instrumental data of seismograms and does not describe how it is felt and the local effect of destruction. The scientific publications and maps of the last decades of the monarchy are a valuable basis for the evaluation of historic sources, which were the basis of modern earthquake catalogues and future classification and processing. See literature cited on the poster.

Keywords: 1895-Lubljana earthquake, macroseismic damage

S. GIRAUDEAU | V. FANTINI | J. DE PAOLA, Italy

"Abandoned Art Nouveau as a research tool: comparing two different methods"

"This research is the extension of previous analysis on the abandoned Art Nouveau building in Italy (where this artistic and architectural tendency was named "Liberty"), starting from the study of the evolution changing of the appeal in this architectural style. Liberty was only popular during the period between the 19th century and the 20thcentury. The Liberty was characterized by a marked linear style and elegant decoration; it became quickly the main style of the growing bourgeoisie. This research will aim to examine the reasons because these particular buildings didn't acquire the "charm of ruin" after their closure and because they often suffer from complete abandon without meaningful chances of recovering. Many buildings in Italy can be clear examples of this condition. The methodology for the analysis of this Heritage at risk will be developed using the photogrammetric survey, using both a traditional 2D approach and the SFM solutions. The aim will be to gain a better understanding using fast and discrete techniques (a lot of these buildings are left to themselves and often protected from public intervention) and the creation of an archive of these findings.

The observed buildings will be chosen in the city of Florence trying to extend the first part of the research that has been started a couple of years ago. In the city of Florence is it possible to appreciate several important buildings, good examples of this brilliant style.

The Architect Giovanni Michelazzi was one the most representative of the Liberty style in Tuscany, he passed away in the 1920, after designing many villas around Florence. The research will be carried out by observing and surveying two important buildings. These surveys will be a possible reference for a conservative intervention or at least a documentation of something that is getting lost. Using two different cameras is it possible to compare the results obtained, this will be an important step for further surveys and research in emergency situation. This project progress our research gaining more experience in photogrammetrical survey.

Keywords: Art Nouveau, abandon, comparison

S. M. GRILLO, Italy | W. PROCHASKA, Austria

The Marble Inventory of the Early Christian Basilica San Saturnino/Cagliari-Sardinia

The San Saturnino Basilica of Cagliari was built in the fifth century A. D. and is situated in the place where, according to tradition, St. Saturnino was beheaded in 304 AD. The early Christian Basilica is considered one of the most significant of the Mediterranean. It is surrounded by an archaeological park, where some excavations have revealed several Roman and Byzantine tombs.

During the centuries the Church underwent many restorations. In the late seventeenth century the building was partly demolished to recover materials for the restoration of the Cagliari Cathedral. After substantial air-raid damage during the Second World War, extensive renovations and partial rebuilding were necessary. The new Church was re-opened to the public not until 1996.

The main construction materials of the church are different local limestones – Pietra Forte and Pietra Cantone – from several quarries in the region. The decorative architectural elements preserved basically are red, grey and white marble columns. The preliminary identification of these coloured marbles so far is Cipollino Rosso from Iasos /Asia minor, and marbles from Lesbos and Carystum. Preliminary petrographic and geochemical studies showed that Carrara marble is the material of the white marble columns. Other fragments of white marbles as column bases, capitals and a

sarcophagus are presently being analyzed for their provenance.

Especially the white Carrara marble columns are in an extremely bad condition due to weathering and the crystallization of different salts, resulting in sugary corrosion and sanding of the columns.

Both provenance studies of the marble inventory and also investigations on the mechanism of the salt deterioration will be presented.

Keywords: Marble provenance analysis, wreathing, restauration

V. IONESOV | V. KURINA, Russia

The things and people: to new creative communication of urban landscape

This poster analyses the contemporary discourse of the philosophical comprehension of sense and preposition of material/archaeological objects in urban environment, with special emphasis on necessity of conceptual clarification the basic notions and their terminological significances in science of things. From an anthropological perspective, this article will critically analyses the things as specific cultural reality. The social and symbolic nature of things are inscribed and interlinked in the historiographical comparison and on the base of semiotic explanations. Author considers the different aspects of existence of artefacts in culture by the material patterns and in the limits of current theoretical knowledge. It is distinguished such concepts as thing, object, subject and artefact in cognitive analysis of material culture. It is necessary not only to distinguish thing as object, but also to show thing as sign and symbol of human relations. The sense of thing is wider than self-thing as one is not only matter, but also thing is that we are thinking about it, how using it and how understand it. An anthropological approach to interpretation of material objects enables to explain the thing as carrier and image of human qualities. The data show that things as important means of cultural changes must be carefully considered in context of urgent tasks of public archaeology and urban landscape.

Keywords: Archaeology, things, creative environment, urban landscape

T. PIGNATALE | A. LEONARDI, Italy

Intangible Heritage, fairy tales and myths, structure for a research about the underground popular imagination and its link to architecture and archaeology

The legends and the myths from the popular culture are a quite common elements everywhere in the world. But when they come to be combined to remains and ancient buildings, often there is some kind of special mix. This mix brings the imagination beyond the works and the ventures of paladins and architects; it brings the imagination in the underground.

So it may happen to hear stories about tunnels, caves, hidden rooms where fabulous treasures are hidden. The size and the possibility to see the place is simply secondary. Most of the time, if no one is able to find those places is considered the demonstration of how it is difficult to discover them.

There are many meaningful examples of these phenomena: from places seen, but only partially explored, to places that have lost the consistence of the myth and are then recognized in their real function, to the places only existing in the collective imagination.

The research structure proposed here will present an approach to this subject, linking together strategies for documentation, digital survey solutions, and techniques for cataloguing the intangible elements from the popular culture. It will propose some important and clear samples like the "Buca di San Rocco" (a cave crossing the rock where a fortress was raised) in Sasso Pisano, Tuscany; the

Cryptoporticus of the Hadrian's Villa in Tivoli (where the legend places the rooms for Hadrian's expiation); the mysterious tunnel in San Marco Argentano in Calabria, imagined as crossing the land from the local castle to a nearby monastery. These samples (and others) will allow to structure a proposal for documenting and interpreting the reasons of this specific fascination, creating not a simple catalogue of strange places and mysteries, but a tool for interpreting the relationship between suggestion and strength of the architectural and archaeological remains in the popular culture.
Keywords: Cultural Heritage, Intangible Heritage, caves, legends, documentation

A. SICHI | C. ROSINI, Italy
S. Johannes in Jerusalem Church, in Poggibonsi. A disclosed mystery?
The research aims to complete the store of knowledge on a monument of nearly a thousand years through the study and interpretation of ancient technological devices that have generated formal and unique characteristics. The absence of documents that has shrouded in mystery the evolutive history of the best preserved in Europe hosting complex along the Via Francigena has been bypassed by the research, which carried out to disclose the Templar's symbolism on one side and the oblivion of time from another.

The object of the research is the small and elegant Romanesque church located in that complex.
The search method based on direct observation, the direct survey of technological and structural devices, punctual measurements aimed at verifying the hypothesis and the reconstruction carried out in the field and not a reworking of data in post-production were distinctive characteristics of the study.
We have achieved original and high contribution to knowledge results. In particular: the decoding of the construction technique of the three cruises freestanding brick vault, unique in its kind as the result of handicraft manufacturers and therefore not categorized according to general patterns textbook; formal interpretation of a singular and unique denticular monofora that has so far left unsatisfied curiosity of scientists; detection of the method for tracing the monument and the proportional relationships used to its location in relation to the existing context; the explanation of the peculiar and irregular orientation of the church; assumptions about the likely dating of the monument, so far uncertain because of the lack of documents.

These results were then allowed to fill those gaps that the studies conducted to date on the monument they left. The research therefore assumes the character of a true discovery and is configured as a valuable reference for similar studies.
Keywords: Templar symbolism, constusction techniques, virtual simulation

S. TARANENKO | S. ROMANCHUK, Ukraine
Reconstructing the ancient landscape in Kyiv Podil: issues of methodology
Dependence of the planning structure of Kyiv Podil in the end of 9 – the beginning of 10 century upon the ancient landscape was noted by experts. However, the real landscape of this period, i.e. local forms of meso-landscape, their shape and dynamics, are still unknown. Archaeological data are fragmentary because archaeological investigations in Podil mostly include the emergency excavations. The issue could be solved with analysis of the object based upon interdisciplinary approach to reconstruction of the ancient cultural landscape during a period of changes in lithogenic base and hydrological structure. Since the territory of Podil belonged to Dnieper floodplain before the 10 century,

it is important to analyze the processes of formation of the floodplain structure and complexes near the hill sloops. The next step includes the complex research of the landscape features in Podil and archaeological objects based upon cartography of the buried landscape and landscape profiles. Historical data should be included into reconstructions as well.

Profiles led to the correlation of the cultural landscapes with the areas of buried streams and rivers. The former were found along the elevation that was located perpendicular to the edge of plateau, from the Zhytnij market to Voloska street. Stratigraphy of excavations sites with the lowest elevations, Zhytnij market (1973), Red square (1971-1973), Heroiv Trypillia-Khoryva (1972) and Spaska 35 (2011), were used for "filling" the profile. Chronology is based upon archaeological data from Ancient Rus cultural layers from the excavations sites along the profile. Analysis of this data led to reconstruction of the formation of strand, the sequence and phases of growth of the elevation in this part of Podil, as well as the development of hydrological network.

Keywords: Ancient landscape, archaeology, Kyiv Podil

I. TOPALILOV | N. TOLEVA | G. KAFELOV, Bulgaria

The Episcopal Basilica in Philippopolis, Thrace (modern Plovdiv, Bulgaria): Challenge of Socialization and Exponation

The Episcopal Basilica in Philippopolis, Tharce is the biggest Early Christian basilica not just in the territory of Thrace, but in Bulgaria. The building is specific for its size (80 metres long, 35 meters wide), and for its rich and intricate mosaic floorings which are a big challenge in terms of conservation, exponation and socialization. The archaeological remains are located in the lively urban centre of the contemporary city. Along the north side of the site runs a major transport artery, which not only hinders the option for the complete excavation and examination of the site, but also detains the exponation of the basilica as a whole. In addition, it hampers the process of conservation and socialization in the already excavated and studied parts of the building (the south aisle, the central nave, the narthex and the part, considered to be atrium). What is unique are the two overlaid mosaic floorings from two different construction periods that cover the nave and the narthex (with overall area of more than 700 square meters). The main objective is developing an innovative approach and suitable technology for separation, conservation, restoration and exponation in accordance to the contemporary principles of preservation. As a result in the current paper, the authors develop a possible solution for preservation and inclusion in the contemporary urban fabric of the archaeological remnants of the Episcopal Basilica, by taking into account all characteristics of the site, and strengthening the link between the ancient town and the modern city, and ensuring the vitality of the site.

Keywords: Mosaic floors, early Christian basilica, conservation, urban socialization

M. BLOCK-BERLITZ, Germany | R. JUNG, Austria / M. PACCIARELLI, Italy
UAV-based topographic surveying at Punta di Zambrone (Italy)
This video showcases the use of UAVs for recording the prehistoric (Bronze Age) site at Punta di Zambrone, Italy (http://www.puntazambrone.com/it/). A coastal site with some striking topography, Punta di Zambrona provides a challenge for ultra-light aerial vehicles, due to strong thermal winds. Another problem was the positioning of georeferencing markers with sufficient visual exposure in the rugged terrain. Nevertheless, the robust UAV technology proved its worth and produced some spectacular video footage from which we were able to reconstruct detailed and stunning 3D models of the site and its surroundings.
Keywords: Punta di Zambrone, UAV, 3D

A. BRAGHIROLI, Italy
Gladiators combat
The Colosseum is the largest amphitheater in the world, already in antiquity it was considered one of the wonders of the world. But it's not only one of the greatest works of Roman architecture and engineering. It is the place where different public spectacles took place during the Roman Empire Age, like mock sea battles, animal hunts, executions, re-enactments of famous battles, and dramas based on Classical mythology. Also served as a monumental framework for gladiatorial contests. Although the Colosseum is still the main landmark of Rome and many people from all over the world visit it everyday, they can only imagine how it would be like to be there among thousands of people witnessing such a dramatic entertainment like gladiators fights.
The concept of the video is to bring to life the actual use of the Colosseum, showing different types of gladiators fighting in the arena. The purpose is to recreate the spectacular nature and the entertainment of the combats, keeping at the same time a rigorous approach to the reconstruction. While the documentation on the Colosseum is extensive and easy to find, it is more difficult to portrait the actual gladiators' specific fighting techniques and movements, each one specifically related to unique sets of weapons, armors and combat gear.
My research for filling this crucial issue led me to some sportive associations whose specific goal is the historical reenactment of those fights, using faithful replicas of the original combat gears. I used footage of those athletes fights to trace their movements and to design the virtual combats inside the Colosseum; also modeled the different combat gears and weapons using as a reference actual archeological findings currently held in Rome and Naples archeological museums.
Keywords: Colosseum, 3D modelling, gladiators

Carlotta CAPURRO / Dries NOLLET / Daniel PLETINCKX, Belgium
Virtual reconstruction of the Egmont castle of Zottegem, Belgium
The Egmont castle of Zottegem is a standing building with a lot of history linked to it. Based upon archaeological and historical research, a virtual reconstruction has been made of the evolution of the

castle and the surrounding landscape. The archaeological information was derived from several excavations plus a scanning with ground penetrating radar. Historical research in the context of this reconstruction project has revealed many more sources and a much better understanding about the evolution of the site and its inhabitants. The video shows briefly a selection of sources that have been used, and shows the evolution of the castle, the city and the surrounding landscape as one long shot, transiting from one period into the other (three periods are covered: 1150, 1300 and 1640). The innovation shown here in the video is the use of high-end digital landscape simulation, based upon archaeological and historical sources, and the link between the sources and the final 3D reconstruction. The realism of the video and the consistency and completeness of the virtual scenes provides the viewer an appealing and entertaining visualisation of the reconstructed periods (see test rendering at https://vimeo.com/98799233). The 3D model is used also in an interactive TimeFrame system in the Egmont castle itself, telling its story throughout the last millennium.

Keywords: medieval archaeology, virtual reconstruction, historical landscapes, visualisation of monuments, archaeological park

B. FRISCHER | P. ALBÈRI AUBER | O. ROSSINI, USA

"The Obelisk, Meridian and Ara Pacis of Augustus"

This video was featured in the exhibition, "Augustus: The Art of Command," which was shown in the Ara Pacis Museum (Rome, Italy) from April to September 2014 on the occasion of the two thousandth anniversary of the death of Rome's first emperor. The video presents a 3D reconstruction of the northern Campus Martius, a part of the city of special interest to Augustus and which he was the first to develop. Several key monuments survive from Augustus' intervention, including the first obelisk brought to Rome (the so-called Montecitorio Obelisk) and the Ara Pacis, a 10 x 11 m altar open to the sky decorated with a series of reliefs that represent the peak of Roman art in the Augustan age. The monuments have been re-erected in new sites in the modern city, and the area of the ancient city where they originally stood has changed beyond all recognition. Only through a 3D reconstruction model could this part of Rome be restored to the way it appeared in the reign of Augustus (30 BC – 14 AD). The team behind the video resurveyed the monuments and created a scientific 3D reconstruction model accurate to +/- 1 cm. It also used altazimuth data from NASA's highly accurate Horizons System in order to simulate the path of the sun through the sky during the reign of Augustus.

The concept is that the video illustrates the proximity and alignment of the Obelisk and Ara Pacis. It also illustrates the innovative published research of Albèri Auber, who showed that the obelisk functioned as the gnomon of a giant meridian whose purpose was to facilitate calculation of the leap year by the Romans. In the thirty six years prior to construction of this monumental complex, the Romans had miscalculated the leap year, which was already in error by three years when Augustus assumed responsibility as pontifex maximus for the maintenance of the religious calendar.

The informational value of the video is high: it shows the way in which the shadow cast by the gnomon onto the meridian moves from year to year in the four-year cycle from one leap year to the next, returning to the initial position in the fourth year. Before the video was created, Albèri Auber had only been able to describe this phenomenon in words and with a static, 2D graphic that was quite hard for people outside the field of gnomonics to read. The entertainment value consists in the lyrical style of

the video used to reinforce the beauty of the monumental complex created by Augustus. In short, the video demonstrates the strengths of Virtual Heritage to bring antiquity to life, make complex mathematical-astronomical calculations intuitively obvious through dynamic illustrations, and inspire young people and the general public to better appreciate the richness of our cultural heritage.

Keywords: 3D reconstruction, archaeoastronomy, Roman archaeology

C. FROMMER, USA

Zimbabwe's National Dombashawa Rainmaking Cave Monument

Inasmuch as monuments pose as sites of national representation, symbolic value therein is inherently contested and resituated by enactments of intangible heritage oriented kinetically to the future by tertiary technologies - such as audiovisual recording devices. The short docudrama Extending Sweetness reveals this potential, fluid and speculative temporality of an intangible heritage (song, dance, ritual) that is enacted apart from the solid, tangible heritage of a celebrated geomorphic cave monument. As national monuments may provoke both ambivalence and active reclamation projects among local communities and nationals themselves, it is important that cultural resource managers, gate-keepers and archeologists explore the virtual and kinetic potential of enacting intangible heritage with local communities. Our film does this by working with contemporary rainmakers and in the the figuration of their spirit-helpers and relatives currently exiled from Zimbabwe's National Dombashawa Rainmaking Cave Monument (managed by the National Museums and Monuments in Zimbabwe).

LANDESAMT FÜR DENKMALPFLEGE IM REGIERUNGSPRÄSIDIUM STUTTGART, Germany

"Entwicklung der Heuneburg" (Development of the Heuneburg) | Language: German

Based on the present state of knowledge about this site of European importance, this short animated film takes us through the development of the Heuneburg during the late Hallstatt period. Produced In full HD, it is both scientifically accurate and easy to understand for the interested public. It was created this year on the occassion of the reopening of the Heuneburg Museum in the hamlet of Hundersingen overlooking the Danube Valley, only 2,5 Kilometres from the Heuneburg itself.

Dries NOLLET / Carlotta CAPURRO / Daniel PLETINCKX, Belgium

Virtex: a tangible interface for museum objects and monuments

Virtex (which is an abbreviation of VIRTual EXhibition) is a methodology to do interactive storytelling based upon an interactive replica of a museum object or monument. The replica, which can have a different scale than the original, is made by 3D printing and contains electronics to make a wired or wireless connection to a computer, that shows the 3D model of the object, if possible with additional information such as colouration or digital restoration, and stories that are triggered by touching the interactive zones of the replica.

The Virtex implementation for museum objects contains a wireless orientation sensor that allows to visualise the digital replica, moving in the same way as the physical replica, with additional information such as the real appearance of the object or reconstructed colouration or digital restoration.

The Virtex Light implementation for monuments does not contain an orientation sensor.

Keywords: tangible interfaces, 3D printing, museum objects, monuments, interactive objects

Ch. REINBACHER | M. HOFER | Ch. MOSTEGEL |G. HOLLER | Th. HÖLL | A. PINZ, Austria | Craig ALEXANDER, UK

3D Scanning in the 3D-Pitoti Project

The video shows the 3D scanning of a large rock panel in Valcamonica (Seradina I rock 12C, approx. 20 x 20m), performed within the European 3D-Pitoti project. The rock is scanned at two spatial scales, at a mid-level by an unmanned aerial vehicle, and at a micro level, by a novel, custom developed micro-range rock-art scanner. A novel on-line structure-from-motion pipeline provides online user feedback about already scanned areas and expected coverage by a sufficient number of images. The micro-range scanner can reconstruct surface geometry in 3D up to approx. 0.1mm, and radiometric surface properties beyond phototexture by using bright custom illumination and a novel frame differencing principle.

St. REUSS | P. KUROCZYŃSKI, Germany

Virtual reconstruction of baroque palaces in former East Prussia

The film is a teaser for the interdisciplinary and international project „Virtual reconstructions in transnational research environments – the web portal "Palaces and Parks in former East Prussia", which presents the complex scope of the young scientific field of Digital and Spatial Humanities, in a slim and comprehensible way.!!The film maker accompanied a group of scientist, who seek to establish new standardized methods of documenting and presenting Cultural Heritage (CH) in, with and via 3D computer reconstructions. They research is focused in the field of semantic data modelling (of the resources and created 3D models) and of appropriate database. The researchers design concepts for documentation standards for born-digital CH.!!This film shall raise the interest in the beauty of the CH by exploring them through different perspectives, including aerial videography. And it shall arise curiosity among the young generation to the new technological possibilities to explore, evaluate, protect and spread the knowledge of endangered CH.!!Archaeology and CH become more vivid and a broader group of people can grasp the fascination and increase the subject's popularity! The film maker increases the tension and builds a story around and with the subject, by switching angles and perspective, growing from frog view, over human perspective to bird eye. On top the film fades between todays reality, historic documents and the latest virtual reconstructions! The film conveys the information about the place of excavation by using state of the art technology and implementing dramaturgical methods, such as changing perspectives (macro, close-up, landscape), fading between reality and virtual reconstruction (scientifically correct digital 3Dcomputer reconstruction), implementation of data from laser scan point-clouds, and similar scientifically profound data.

Keywords: Virtual reconstruction, architecture, project-teaser

E. VREENEGOOR | ECHO tekst&presentative, The Netherlands

De Maas uitgediept (The Meuse in depth) | Language: Dutch

Climate change and recent flooding led to a huge program in the Netherlands to strengthen the river dikes and deepen the rivers in order to make space for floodwaters in the future. This project, of course, has a huge impact on the landscape an the archaeology in the river areas. In order to bring the heritage aspects into the mind of the engineers the Cultural Heritage Agency has made a video, in cooperation with Echo tekst&presentaties, on the history of the Meuse river. This video contains 3D reconsructions and new archaeological and geological research. The whole video has been made as an informative, yet entertaining film in order to reach a wide public.

Keywords: Landscape archaeology, maritime archaeology, Romans, Middle Ages, river safety

Daniel PLETINCKX | Dries NOLLET | Carlotta CAPURRO, Belgium

The virtual reconstruction of Ename

Ename has been founded as a trade settlement at the river Scheldt around 965 AD. Around 985 AD, it became also the local capital of the region. It had a major harbour, one of the earliest stone keeps in West-Europe, a palace building and local production of several products, such as linen, pottery and jewellery. The Saint-Laurentius church is a still standing monument of that time, containing the oldest murals of the Low Countries, including a very high quality fresco of a Maiestas Domini. When it is destroyed (1033 AD) and annexated (1047 AD) by the count of Flanders, the trade settlement is replaced in 1063 AD by a Benedictine abbey that dominates the village until 1795 AD.

The site has been excavated for more than 30 years, in the period 1942-1947, 1978 and 1982-2004. In the 1990s, the evolution of the Ename landscape was studied in detail and published. A geophysical survey (resistivity and magnetometer) has been executed in 2003. The extensive archaeological and geophysical research and the in-depth historical study of the trade settlement, abbey and surrounding landscape give a solid base for the virtual reconstruction of the site and its surrounding landscape. In the period 1997-2004, a virtual reconstruction of the site has been made for 13 phases in the period 1020-1780. In the period 2012-2014, 9 phases have been revised extensively and completed with landscape simulation, based upon the available landscape studies. Currently, Ename has a museum, an archaeological park, a registered monument, a historical nature reserve and a heritage centre. Visual Dimension has its offices in Ename. The video shows the virtual reconstructions, made by Visual Dimension since 1997 and its different presentation forms for the public, on the archaeological site, in the museum and in the heritage centre.

Keywords: Ename, virtual reconstruction, historical landscapes, archaeological visualisation, interactive 3D visualisation

Daniel PLETINCKX | Dries NOLLET, Belgium

The virtual reconstruction of the WW I Battery Aachen

The archaeological park Raversijde (Oostende) at the Belgian coast contains the remains of the German coastal defence system (Atlantikwall) of the first and the World War II. As the remains of the defence system of the World War I were re-used in the World War II, it is difficult to have a good idea of these coastal defence structures through virtual reconstruction as physical reconstruction is not an

option. The video shows these virtual reconstructions related to the preserved archaeological remains and other sources (photos, maps, texts). The video wants not only to recreate the atmosphere of these coastal defence structures, which were small villages on their own, but also give the visitor of the archaeological park a lot of visual clues about the original state of the site, while exploring the current site. The virtual reconstructions will be used in a new museum that will be opened in 2015 at the archaeological park.

The virtual reconstructions bundle a lot of historical and archaeological interpretations into one consistent 3D model, which is therefore acting as a kind of knowledge base. The 3D model also contains procedural landscape reconstruction, which not only gives the images a high degree of realism (and entertaining images – the landscape reconstruction software was also used in Avatar) but provides also a scientific documentation of the reconstructed landscape.

Keywords: World War I, virtual reconstruction, historical landscapes, visualisation of monuments, archaeological park

Panel Discussion – CULTRUAL HERITAGE in DANGER

"Archaeology is a finite resource under threat". As archaeologists, we can do little to combat the damaging effects that armed conflicts, population pressure, political corruption and encroachment on protected areas have on our heritage.

However, we can use inexpensive and readily available technology to document sites, monuments and objects so that, in case of their physical destruction, at least some accurate digital records will remain. We also have complex spatial data management software at our disposal, enabling us to make better use of the little resources we have to monitor and protect archaeological sites.

Perhaps most importantly, the Internet and world-wide communication tools allow us to reach out to volunteers globally teach and motivate them to become actively involved in caring and preserving their own local heritage.