



Congress Visual Heritage
November 12-15, 2018 | Vienna, Austria

CHNT

23

VH VISUAL HERITAGE

Digitize: Research - Record - Reactivate - Reconstruct
hosted by CHNT 23 2018 | Vienna, Austria - November 12 - 15, 2018

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Vienna 2018

23

Congress
Visual Heritage 2018
hosted by CHNT
November 12-15, 2018
City Hall, Vienna, Austria



Visual Heritage 2018 | CHNT 23

DIGITIZE: RESEARCH – RECORD – REACTIVATE – RECONSTRUCT

Visual Heritage 2018 hosted by CHNT 23 2018

(Vienna, Austria – November 12 – 15, 2018)

The next edition of CHNT (Cultural Heritage and New Technologies – www.chnt.at) will be organized in cooperation with the [EG GCH \(Eurographics Symposium and Graphics Cultural Heritage\)](#) and other partners in the City Hall of Vienna Austria.

The aim of this federated event is again to bring different communities in the same venue, to share experiences and discuss methodologies concerning digital visual media and their use in the context of heritage applications, to document digitally on at-risk archaeological sites, historical buildings, museums... and their texts, books, paints, pictures, objects ...all records of through collecting original image collection's source.

The 2018 edition will be a special event, since 2018 has been declared by the European Commission the "European Year of Cultural Heritage". The event will also take place during the Austrian Presidency of the Council of the European Union, at 2nd half of 2018.

Therefore, Visual Heritage 2018 will be an ideal context for discussing European policies on digital heritage and digital humanities.

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Abstract Volume

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Key Note Speeches 2018

Lior WOLF, Israel

Four deep learning approaches for overcoming domain shift in Cultural Heritage

Abstract: I will describe four strategies for building robust models that are able to generalize beyond specific training datasets. The first is applied in the context of computerized archeology as part of the ArchAIDE project, two methods are employed in the context of document analysis, and the last one is applied to generate music and was done by the Facebook AI Research team at Tel Aviv.

(i) By employing a point-net like architecture, coupled with domain-specific augmentation, we are able to learn to identify images of pottery sherds from synthetic 3D data. The method can handle the varying shapes in which a 3D model can break, and manage to classify the sherds by the shape of the fracture alone.

(ii) By designing the network to be language- and style-agnostic, we obtain a generic word detector. Our approach efficiently detects words in a variety of scanned document images, including historical handwritten documents and modern-day handwritten documents, presenting excellent results on various literature benchmarks.

(iii) By using virtual samples, we are able to train a Handwritten Character Recognition system on purely synthetic data and apply it to ancient documents. We focus on low resource languages, and , for example, present a very significant increase in transcription accuracy for a test set of 167 images from the bKa' gdams gsung 'bum Tibetan collection.

(iv) By reusing a single music encoder network, we are able to perform convincing translations across musical instruments, genres, and styles. Employing a diverse training dataset and large net capacity, the domain-independent encoder allows us to translate even from musical domains that were not seen during training. The method is unsupervised and does not rely on supervision in the form of matched samples between domains or in the form of musical transcriptions.

Franco SOLINA, Slovenia

The use of pictorial information in cultural heritage beyond visualisation

New sensors and methods for recovering the 3D shape of cultural heritage can generate huge amounts of 3D data, mostly as clouds of 3D points covered by photographic texture.

Such data can partially replace classic forms of documentation in cultural heritage. But in this moment in time, 3D data demonstrates its usability primarily for presentation and visualisation of cultural heritage. This is a very important and worthy goal for promotion of cultural heritage first and foremost for the general public.

But how can all this digital heritage trend be used by professionals, such as archeologists and art historians, to facilitate their principal job of interpretation and understanding of cultural heritage?

Computer vision, as a part of artificial intelligence, offers many useful tools and methods for analysis of visual information. In my presentation I will illustrate how some of those tools can help in the analysis of cultural artefacts in the context of underwater archeology and preservation of water-logged wood. At

the end I would like to foresee what will be the challenges when the cultural heritage domain fully enters the big data era.

SESSIONS

APP – Session

Chairs: Michael KLEIN | Günther WEINLINGER, Austria

John FILLWALK, USA

Virtual Companion

Keywords: augmented reality, locative application, cultural heritage, iOS

Abstract: The IDIA Lab at Ball State University created their Virtual Companion app as a custom augmented reality app employing LocusEngine technology - a geolocate process developed by IDIA Lab. Visitors to a site employ the app to aid in learning and discovery while exploring any outdoor site. Using GPS data, the user's position is geolocated in reference to the historical sites, allowing the app to display relevant content as a dynamic guide. This approach can be applied in cultural heritage, archeology, the sciences and the arts.

The pilot project digitally illuminates an Adena-Hopewell native American earthen mounds site. This project engages asynchronous Interactive menus, as well as the user's live location in the park - displayed via a series of options designed to provide multiple layers of locative mapping and data. A GPS-driven site map is available, allowing the user to track their movement through significant mounds features. Location drives data that is pushed to the viewer automatically without the need for interface. When an interactive feature is selected on the map, an augmented reality view using gyroscope and compass data is loaded, portraying augmented reality views from the Adena-Hopewell era. Archaeologists have proposed that the enclosures were used to track celestial alignments. Using solar data from NASA's JPL Horizons database, the movements of the sun on the equinoxes and solstices during the Adena-Hopewell era can be viewed and tracked to search for important alignments. The app is available on the Apple AppStore.

Emily FLETCHER, USA

Mapp

Keywords: Digital Archaeology, Archaeological Documentation, Archaeological Mapping

Abstract: Although mapping and documentation are two of the most important processes in archaeology, the common paper techniques are inefficient. Paper documentation in general endangers data—paper is often difficult to preserve on an archaeological site, and handwritten documents by their nature prevent data replication. Additionally, the paper mapping process adds extra inefficiency to the archaeological process. Hand-drawing paper maps is extremely time-consuming, and the resulting maps are monochromatic and difficult for the human eye to interpret. Improving these techniques could revolutionize archaeology by revitalizing its most important processes, allowing projects to progress more quickly, and even facilitating interpretation—the purpose of excavation.

Mapp, an Android application, can make the mapping and documentation processes more efficient by solving these problems. The app stores data both on the user's mobile device and on an online server from which it can be accessed by a desktop computer. This protects data by duplicating it and by

storing it in a medium which is more durable than paper. Most beneficially, Mapp solves problems which plague traditional mapping techniques. Mapp allows a user to save a photograph of their unit in place of a traditional, hand-drawn map. This replaces the tedious mapping process with simply the click of a button. Although hand-drawn maps can contain more information than photographs, Mapp accounts for this shortcoming. In Mapp, a user can highlight on a map to save that selection to a key containing more information. Through these and other functionalities, Mapp can bring about a “paradigm shift” in archaeology (Jeremy Huggett, "Challenging Digital Archaeology," Open Archaeology, 2015 [1], 79). It will not only save archaeologists time, but will also facilitate interpretation on a grander scale than has previously been feasible with traditional mapping and documentation techniques.

Marion GROßMANN | Konstantin HÖBART, Austria

AR + VR = XR

Keywords: Virtual environment, Visualization, Image reconstruction, data visualization

Abstract: The archaeological site of Carnuntum situated roughly 50 kilometres east of Austria's Capital Vienna is Austria's largest archaeological complex and has been known for more than 130 years.

During the 1940s and 1950s, several buildings in the so called „Spaziergarten“ were excavated, but afterwards covered again in order to protect the roman heritage.

In the past 10 years, three houses in the city quarter were reconstructed by using experimental archaeology. But what possibilities do we have to make those parts of the City visible for our visitors, that are still remaining untouched below the surface?

For the upcoming Season, starting in March 2018, Carnuntum enters a new level of presenting the roman city quarters for the visitors. Together with 7reasons, the so called Carnuntum App was developed and can be used as a helpful gadget to start virtual adventures in the different areas of the roman City. The App is free of charge and can be used in the City Quarter, the Amphitheater in Petronell-Carnuntum and the Gladiators School nearby. All views are precisely described in terms of position and perspective. With the help of virtual and augmented reality, the roman city comes to life again without endangering the ruins beneath the earth.

Peter GRUNDMANN, Austria

Hearonymus - your personal audioguide

Keywords: Culture for all

Abstract: Hearonymus is a young Viennese company and it brings culture to everyone. Free and easily. No matter where you are and no matter if you have any restrictions or disabilities or not.

How do we get there?

On the one hand Hearonyms offers a free app, a platform for professional cultural audioguides. You can find, download and listen to free guides for world heritage sites, for museums, for cultural sights, for architecture walks, for caves, for excavations, As all guides run offline after the download, so it is running everywhere. And the guides are available in lots of different languages. As we are using not

only audio but also pictures, maps, videos and so forth the correct expression would be multimedia guide instead of audioguide.

On the other hand, Hearonymus supports cultural institutions to create their own audioguide. And our help is flexible and you can have it at an unbeatable price. For an audioguide five steps need to be taken. Number 1: You need a text. Number 2: if your audioguide shall also be used by people from other countries you need translations. Number 3: professional native speakers for every language are necessary 4. You need a recording studio and number 5: you need someone who brings all the stuff that has been produced in steps 1-4, to the smartphone. We can help you with all five steps but 1-4 you can produce yourself.

For institutions this means no equipment costs, no costs for maintenance and service, no charge for handling and theft of the guides, as the visitors come with their own mobile phones. And the audioguides lead to additional visitors because the platform arouses interest.

Hearonymus started in 2013. Today we have more than 600 professional cultural audioguides on the platform. In Austria we are already number one and one year ago we started in Germany. In June this year we started in Switzerland.

Sandra L. LÓPEZ VARELA, Mexico

Mexico Alternativo/Alternative Mexico

Keywords: Heritage, Preservation, Planning, Development, Mexico

Abstract: “Alternative Mexico” is a mobile application drawing from the need to preserve and promote contemporary heritage resources that are of great value to Mexico’s citizens. Mexico’s heritage is preserved in terms of its monumentality, its relevance to the history of the nation, and within the aesthetics of Mexican nationalism. Infrastructure building and promotion of urban lifeways to modernize and strengthen Mexico’s economy, has resulted in the appropriation by its citizens of modern spaces, with the inevitable creation of new heritage values. These new heritage resources oppose the national definition of cultural heritage and are the main the main source of conflict during infrastructure planning and building.

How to effectively connect new heritage values to the national heritage preservation model and, at the same time, convey this rich and varied cultural heritage to those involved in planning and building for their preservation and to those visiting Mexico is the concept behind the design of this easy to use web-based (mexicoalternativo.com.mx) mobile application for iOS and Android platforms What makes us different is how we have built its contents, through a strategic alliance with Mexico’s citizens as part of a value chain teaching-research transfer. Students interview their neighbors within 1 km in diameter and research the area. The website and the app give the user the opportunity to add a place of interest by filling up a simple form, even loading a photograph.

The App is entertaining and educational. The application takes you to a menu listing the areas where heritage resources have been recorded. Clicking into the selected item takes you to an active or an offline Google map, pinpointing each heritage resource, displaying a simple and engaging text in Spanish and English, and a photograph or you can simply direct yourself to that point and visit it directly.

Maria Cristina MANZETTI | Nikos PAPADOPOULOS, Greece

Experiencing an ancient performance in a Roman Theatre

Keywords: ancient theatres, Virtual Archaeology, auralization, head-mounted display

Abstract: A detailed study about the architecture of the Roman theatres of Crete has enabled formulating new hypotheses about their original aspect. In order to make this information available and attractive for the general public, a VR application for head-mounted display has been utilized. The idea is to let the users choose among six of the 3D reconstructed Roman theatres located in the island of Crete, Greece and to virtually transport them within the ancient theatres, in order to let them discover more about their history through interactive informative icons and panels. The panels explain, through texts and videos, the history of the monuments, their architectural characteristics and their location with respect to the island of Crete. They contain pictures of the ancient theaters, as well as drawings of their architectural design. Further panels indicate the level of reliability of the reconstructions for each sector of the theatres (seating area, central corridors and scene building) plus the sources and the tools employed to design the final hypotheses. The virtual navigation includes among others the capability to listen to an ancient performance (from several seats that the users can select), which sounds exactly as if it would have been recorded in the selected spot, thanks to the auralization process. This VR application, when used directly on the archaeological sites or in the museums, would contribute to make the experience of the visitors more stimulating, educational and entertaining. The possibility to choose which theatre to visit, which seat to sit and which information to visualize, together with the sense of immersion, can keep the users engaged, facilitating the learning process.

Javier ORDOÑO | Iker ORDOÑO | Arantxa SATRÚSTEGUI | Gonzalo ÁLAVA, Spain

Arkikus - Santa Catalina de Badaia Monastery: a Virtual Reconstruction

Keywords: Mobile app, Heritage Virtual Reconstruction, Monastery, Middle Ages, Spain

Abstract: "Arkikus - Santa Catalina de Badaia Monastery: a Virtual Reconstruction" is a brand-new mobile app aimed at bringing to the public the historical site of Santa Catalina de Badaia, located in Iruña de Oca (Basque Country, Spain), through the use of new technologies.

To this end, a range of up-to-date techniques such as drone-based photogrammetry, HQ 3D modelling and rendering, and 360° VR imaging, together with a detailed archaeological and written documentation, have been integrated to virtually reconstruct the architectural and past living spaces of the site over time, seeking the finest possible historical accuracy and educative value.

The site held a Late Medieval aristocratic tower-house that became firstly a Hieronymite, and then an Augustine enclosed monastery during the 15th century AD. The monastic complex remained in use until being seized by the Spanish Government in the mid 19th century. Today, it hosts a renowned Botanical Garden that stands out because of its fine landscaping and intrinsic heritage value.

The app is the first heritage VR tool developed in northern Iberia and provides the opportunity to make this site reach the broad audience in different ways:

as a highly-visual tool that allows the users to immerse in the spaces and biography of the monastery both in situ or at home, which may be especially helpful for impaired people,

as an audio-guide that permits the public to know the history and main details of the site, especially thought for blind and partially sighted people, and

as a document that can be brought by the users themselves in their personal devices, avoiding the need for less-sustainable leaflets and books.

The app takes advantage of current developments and trends in heritage curation and is expected to be adapted to other European historical sites in the future.

Archaeology and Cultural Heritage in Conflict Areas

Chairs: Benjamin DUCKE, Germany | Ann DEGRAEVE, Belgium

Numerous World Heritage Sites, archaeological areas and monuments of all kinds, are under acute risk from the destructive effects of natural disasters and armed conflicts. The wars in Syria and Yemen are stark reminders of the volatility of our shared cultural heritage, as are the recent earthquake in Nepal and the deteriorative effects of global climate change.

There are many agents of impact and destruction, both natural and man-made, that can be hard to assess and impossible to control. Frequently, the discussion of who profits from the destruction of monuments or the redevelopment of destroyed historic town centres defies simple attempts of directing blame to specific groups or individuals. Looting can be a result of economic hardship, as much as that of an insatiable hunger for decorative antiquities by foreign elites. Legitimate military activities, the installation of camps and training grounds, as well as collateral damage can affect archaeological sites as much as intentional destructions by religious radicals. And the manifold impacts of climate change on land-use practices and site preservation are just beginning to become visible.

Furthermore, post-war/post-disaster rebuilding can be extremely and permanently destructive to what remains of historic urban fabric. Many European towns and cities have learned this lesson after the Second World War. Nevertheless, it seems unavoidable that restoration and improvement of civil infrastructure take precedence. Such complex contexts and processes call for a renewed assessment of the possibilities and capabilities of current archaeology and heritage management in conflict and disaster areas.

Silvia FLORINDI | Luca BACHECHI | Anna REVEDIN, Italy

The fragility of the sign. African rock art in the archives of the Italian Institute of Prehistory and Protohistory

Keywords: Immersive exhibition, Digitization, Archives, African rock art

Abstract: Paper is fragile, but so is rock. The Italian Institute of Prehistory and Protohistory (IIPP) choose to take fragility as the main theme to communicate the heritage of the Institute, more specifically that of the photographic archive which conserves evidence of one of the most ancient human heritage at risk of disappearing, forever. The IIPP archive consists predominantly of the images and films related to Prehistory, produced by its founder Paolo Graziosi between the 1930s and 1970s, during several missions he carried out to study the rock art of the Horn of Africa and Libya, especially in the "Rock-Art sites of Tradart Acacus", which has been inscribed in the UNESCO World Heritage list since 1985 and in the "World Heritage in Danger" list since July 2016.

The digitization project has given rise to the exhibition "The Fragility of the Sign. African Rock Art in the Archives of the Italian Institute of Prehistory and Protohistory". The exhibition aims at protecting the photographic archive left to the Institute by its founder, and to make it accessible to the greater public.

Through an immersive itinerary, it was possible to make known some of the most ancient and extraordinary examples of human artistic expression, situated in places that are currently inaccessible as a result of domestic and international conflicts.

Relevance for the conference: Share an experience of public archeology carried out through the use of visual and immersive technologies

Relevance for the session: Discuss and share a strategy of study, conservation and enhancement of cultural heritage located in war zones

Innovation: The concept of fragility, as a weakness of our archives and of human heritage, but also as a key to open public consciences.

Sofia MENCONERO | Angelo BARILI | Giovanni BOSCHIAN | Marco CHERIN | Elgidius B.

ICHUMBAKI | Dawid A. IURINO | Fidelis T. MASAO | Jacopo MOGGI CECCHI | Giorgio MANZI, Italy

3D survey in extreme environment: the case study of Laetoli hominin footprints in Tanzania

Keywords: SfM; 3D documentation; paleoanthropology; Laetoli; footprints.

Abstract: Many cultural assets are in risky situations and they are destined to disappear. Sometimes problems are caused by the anthropic component (e.g. wars) or by natural disasters (e.g. earthquakes and landslides). At other times the cause of deterioration is due to the slow and inexorable action of atmospheric agents and other natural factors present in extreme areas, where preservation of Cultural Heritage is more complex.

This contribution deals with 3D documentation of paleontological excavations in extreme contexts, that are characterized by unfavorable climatic conditions, limited instrumentation and little time available. In particular, the contribution is focused on the search for a good working procedure which, despite the problems mentioned above, can lead to valid results in terms of accuracy and precision, so that subsequent scientific studies are not compromised.

The proposed case study concerns the recent discovery of fossil footprints at the Site S in Laetoli, within the Ngorongoro Conservation Area (Tanzania), which is a UNESCO World Heritage Site. With the new discovery of Site S it was necessary to implement a 3D survey operative protocol with limited equipment and in a very short time. The 3D models, obtained through the Structure from Motion technique and topographic support, were used to perform morphological and morphometric investigations on the new footprints. Through the analysis it was possible to estimate height and weight of the footprint makers (hominins of the species *Australopithecus afarensis*). The collected evidence supports marked intraspecific variation in this species, pointing out the occurrence of a considerable difference in size between sexes and suggesting inferences on reproductive behavior and social structure of these ancient bipedal hominins.

The contribution shows how important is to obtain good 3D documentation, even in extreme environment, in order to reach reliable results for scientific analysis.

Relevance for the conference: A contribution about 3D documentation of a paleontological site aimed to scientific analysis.

Relevance for the session: A contribution about 3D surveys of paleontological finds that are destined to disappear due to adverse weather and natural conditions.

Innovation: Development of a specific workflow for 3D surveys in extreme environment.

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Josephine SCHOENEGER | Holger HITGEN, Germany

Documentation - Observation - Evaluation. Ancient Yemen Digital Atlas (AYDA). A WebGIS based monument information system

Keywords: Yemen, GIS, Digital Atlas, Site Management

Abstract: Almost unnoticed by the world public, the war in Yemen is destroying a unique cultural heritage.

Due to a lack of accessibility and information, it is difficult for the Yemeni General Organization of Antiquities and Museums (GOAM) to document these damages on site, so that hardly any countermeasures can be taken to protect the cultural heritage.

Since 2017 the Sanaa Branch and the IT department of the German Archaeological Institute (DAI) developed a WebGIS based monument information system of Yemenite sites. Financed by cultural conservation funds from the Federal Foreign Office, the system is to be linked with various databases that contains historically, archaeologically and conservatorily relevant data.

System tasks will be research, monitoring and management of Yemeni sites, not only operated by the DAI, but in particular by the Yemeni antiquity authority GOAM, which can enter its own data into the system.

Up to now about 3500 archaeological sites could be mapped and important site plans digitized. Besides the digitalization of published sites and storage of factual data, site management is an important aspect in the creation of the digital atlas. By monitoring satellite images, changes in the state of conservation of archaeological sites can be quickly and clearly detected and structural changes caused by destruction or looting can be documented.

A WebGIS developed especially for AYDA, whose user interface will be available in English and Arabic, will enable GOAM not only to use archaeological data scientifically, but also to plan measures for the preservation of their own cultural heritage.

The presentation explains in detail the tasks of AYDA and the current state of work.

Visualizing Controversial Heritage

Chairs: Willem BEEEX, | Benno RIDDERHOF, The Netherlands | Giorgio VERDIANI, Italy

Jorge Luis Borges wrote in the second part of the 20th century a short story called “The library of truth” in which a planet exists where all the information in the universe ever produced is stored. So the absolute truth must also be somewhere on that planet.

Marshall McLuhan wrote in the same era: “Understanding Media” and more famously “The Medium is the Message.” He states that at a certain point in time the intrinsic meaning of a subject becomes subservient to the medium used to present it.

Both statements apply 100% to visual heritage but also to the developing controversy around visual heritage in each generation.

Heritage is or becomes controversial when a society changes its approach towards it. Not only now, but also in the past. A Roman would thoroughly enjoy bloody gladiator games or a good crucifixion (bring the snacks), but nowadays society looks at it with abject horror. More recently the statues of generals fighting on the losing side of the American Civil War have become a subject of intense debate in the USA.

We try to be objective as possible creating reconstructions of a heritage subjects with all tools available. But is the result a confirmation of the current thinking in society, an exaggeration of the current feeling in society towards the subject or something totally different?

We would like to invite speakers who have dealt with heritage that was controversial but not anymore, or speakers that researched heritage that was not controversial but became controversial or colleagues that have dealt with heritage that always was and still is controversial. Also we would like to invite speakers on a heritage subject that is at the same time considered controversial and not controversial.

What were the challenges, the objections and how was it solved or not solved. What can we learn from it.

Jaap Evert ABRAHAMSE | Menne KOSIAN | Rowin van LANEN, The Netherlands

The Lure of the Golden Republic. Non-colonial Dutch heritage in South Africa

Keywords: Mutual heritage. The Netherlands. South Africa. Dutch neo-renaissance architecture.

Abstract: The Dutch were a seafaring nation, and the Netherlands became a colonial power, adding Surinam and Indonesia to their territory. Dutch colonial heritage has been studied extensively. In South Africa, the Dutch presence was not as lasting. Their Cape Colony fell in English hands, causing an exodus to the Transvaal. The sovereign Zuid-Afrikaansche Republiek (ZAR) was one of the Boer states battling the Zulus, the Sotho – and the British Empire. The ZAR won the first Anglo-Boer War (1880-81) and during a brief interlude they could dream of a Boer Arcadia. The discovery of gold in 1885 provided them with the means to modernize the country and its infrastructure. Dutch architects, engineers and planners were hired to develop this ‘Golden Republic’; from an isolated frontier settlement, its capital Pretoria turned into a modern European-style capital. In only fifteen years a very interesting, but undervalued building production was created from scratch – the only link from the Transvaal plains to the nearest harbour being a 600-kilometer ox-wagon trail. This is not colonial

heritage: the ZAR was an independent state. It is controversial because of the involvement of black and coloured people, and the continuous state of conflict. Most Boers even loathed the Dutch, the creators of their buildings. It has hardly been studied; first the Transvaal was claimed by the British, and while the rest of the world decolonized, South Africa chose for institutionalized Apartheid and isolation. In the present society, facing economic instability and violence, its survival is uncertain, as no one seems to claim its ownership. The Cultural Heritage Agency is involved in research of this heritage, which covers a crucial chapter in the bloody history of South Africa. In this paper we will argue that data collection, documentation, and research are crucial, whatever happens to these buildings.

Relevance for the conference: This paper is about an international cooperation between states and ngo's to research and protect controversial heritage

Relevance for the session: This paper deals with virtually unstudied controversial heritage that is between a rock and a hard place as no one is really claiming its ownership.

Innovation: This is multidisciplinary research of a topic that can only be studied effectively by a multi-national team.

References:

- Jaap Evert Abrahamse, 'The making of an architect. Dutch émigré architects to the ZAR and the context of architectural education in the Netherlands 1850-1900', Karel A. Bakker, Nicolas J. Clarke & Roger C. Fisher (eds.), *Eclectic ZA Wilhelmiens. A shared Dutch built heritage in South Africa*, Pretoria 2014, 6-21.
- Jaap Evert Abrahamse & Nicolas Clarke, 'The Lure of the Golden Republic. Architectural exchanges between the Netherlands and the ZAR 1887-1900', Karel A. Bakker, Nicholas J. Clarke & Roger C. Fisher (eds.), *Eclectic ZA Wilhelmiens. A shared Dutch built heritage in South Africa*, Pretoria 2014, 25-47.

Bogdan BOBOWSKI, Poland

Gebirgsbauden forgotten community of religious refugees from the Thirty Years' War in the Karkonosze (Giant Mountains).

Keywords: religious refugees, Thirty Years' War, colonization, mountain settlement, heritage in the forests

Abstract: The settling movement in the high parts of the northern side of the Karkonosze was caused by the Thirty Years' War in the 17th century and lasted until the early 1950s. The basic difficulty is the lack of sources for various chronological periods within the almost 400-year history of mountain settlement. The materials preserved in the State Archives cover only two decades of the 2nd half of the 19th century, the years 1900-1945 and much less information from the first half of the 19th century. Non-invasive archaeological research was carried out at the Forstlangwasser settlement and the LIDAR data was interpreted and checked in the field for other locations of settlement facilities: Baudenbusch, Baudenwinkel, Baudengärten, Finkelbauden, Niederstädtel and Oberstädtel. The consent for archaeological research was issued by the land owner reluctantly (Lasy Państwowe). The postulate of the lack of interference (archaeological exploration) in the forest environment has been preserved. The research attention was focused on the reconstruction of facts from settlers' life on the

basis of modest archival data. The fate of the settlers living in the high-lying mountain valleys and on the slopes of the Karkonosze ridge were certainly dependent on their strength on demanding positions in strengthening Protestantism. Extremely determined for over 350 years, they have been effective advocates of the new faith, f.e. Hans Ulrich Schaffgotsch. The potential of archaeological discoveries goes far beyond the capabilities of historical data. In 1950, the Forstlangwasser was liquidated by the state authorities due to the search for uranium by the Russians and the resettlement action initiated in connection with it. After the liquidation of the mine in the years 1953-1955, all the facilities, buildings, farm buildings were devastated and construction residues of the houses were looted by local farmers.

Relevance for the conference: 400 years anniversary of the commencement of the Thirty Years' War and great religious migrations

Relevance for the session: Problems of studying monuments destroyed by local authorities and people in the past

Innovation: Modest historical and archaeological research on mountain settlements in the Giant Mountains

References:

- Zarys Dziejów osad górskich dawnej gminy Budziska (Gebirgsbauden) w Karkonoszach- Bogdan Bobowski - Wrocław 2017

Bogdan BOBOWSKI, Poland

A settlement turned into a wilderness - how the Polish People's Army abolished the mountainous village Groß Iser.

Keywords: Groß Iser, displacement, remote sensing, LIDAR, archaeology of XX-th Century

Abstract: The cross-border village of Groß Iser was located in the south-western part of Silesia in Poland, in the Izera Mountains, at an altitude of 840-860 m above sea level. In the vicinity of a non-existent village, the Polish-Czech border runs today and the area is referred to as the Mecca of MTB cycling in the summer and cross-country skiing in the winter. The village of Groß Iser, was removed from the human settlements after II World War. Place was founded by the religious refugee from Czech - Tomasz in 1620. After the First World War, there were 43 residential houses, 2 hostels, 2 inns, customs office buildings, school and a fire station. From June 1945, the population was displaced. The border region was controlled by the army. Abandoned buildings were penetrated and plundered short time by Red Army and then for many years by Polish People's Army soldiers. There are several theories about why the village was destroyed. Certainly the accelerator was the proximity of the state border. Perhaps it was blown up by Polish sappers. There is also a thread of artillery exercises. It is certain, however, that total destruction took place within 7 years in the period from 1953 to 1960. A small amount of historical archives does not help in the reconstruction of the history of the settlement. The launch of my project included field verification of LIDAR data and prospection using the UAV device. My paper will be based on the analysis of historical sources and aerial photographs, LIDAR data and fieldwalking. The settlement, located in a remote area, survived the turmoil of several wars but was destroyed by political decisions and boldness of simple soldiers. It is not easy to recall this story when the children of the destroyers are still alive.

Relevance for the conference: Settlement in the Izera Hall has never been studied because it was a politically sensitive topic

Relevance for the session: Problems of studying monuments destroyed by local authorities and people in the past

Innovation: Modest historical and archaeological research on mountain settlements at the cross-border regions

References:

- Tomasz Rzeczycki, *Utracone Sudety, tropem miejsc które zniszczył PRL*, Kraków 2014.

Radosveta KIROVA, Bulgaria

Transforming Augmented Reality Revival of the Monument 1300 Bulgaria in Sofia

Keywords: visual heritage, public art, communist monument, augmented reality

Abstract: Built the socialist regime to commemorate the 1300-years anniversary of the Bulgarian State as part of the National Palace of Culture complex the most controversial – and probably the most prominent object of public art in Sofia the angular monument used to provoke debates from the very moment of its construction in 1981 until its demolition in July 2017. Although the integration of national symbols such as the sculptures of the most powerful medieval Bulgarian ruler King Simeon and the authors of the Cyrillic Alphabet the brothers Cyril and Methodius as well as the slogans written by the national heroes from the 19th century Revival period Vasil Levski and Hristo Botev, the modernist interpretation of the authors of the monument for representation of the “evolution of the Bulgarian spirit” in the spiral shaped 35-meters-high steel structure left misunderstood for the general public - it was left in decay for the last two decays and finally demolished in the summer of 2017.

In the last two decays the new digital methods of research and documentation that become part of the UNESCO chart in 2003 has changed profoundly the heritage protection area by shifting the paradigm of “memory” and its contemporary interpretation as virtualization of heritage.

The paper reviews in brief the construction history of the monument 1300 Years of Bulgaria in Sofia, the efforts for its contemporary visual rearrangement via 3d-mapping artistic actions organized by Transformatori association in the period 2012-2014, the public debates and the monument's demolition in 2017 as well as the latest initiative from 2018 for its preservation as visual heritage by launching an augmented reality revival software application which provides the transformation of the controversial object into visual/virtual heritage by implementation of an innovative tool for heritage protection.

Relevance for the conference: After the demolition in 2017 of the monument "1300 Years of Bulgaria" an initiative intends its preservation as part of Sofia's cultural heritage by implementation of augmented reality application.

Relevance for the session: Case study of the most controversial public art object in Sofia and its preservation via virtualization.

Innovation: Implementation of the innovative way of heritage preservation via transforming the controversial heritage into visual/virtual heritage: case study of the monument 1300 Years of **Bulgaria**.

References:

- Stanoeva, E. Bulgaria's 1,300 Years and East Berlin's 750 Years: Comparing National and International Objectives of Socialist Anniversaries in the 1980s in CAS Working Paper Series, Sofia, 2017;
- Mihov, N. Forget Your PaYour Past - Communist Era Monuments in Bulgaria, Janet 45 Publishing House, Plovdiv, 2012 st - Communist Era Monuments in Bulgaria, Janet 45 Publishing House, Plovdiv, 2012

Teodora KONACH, Poland

Mapping Communities' Heritage – Community-Based Intangible Cultural Heritage Visualization and Cities with Disrupted Cultural Continuity

Keywords: intangible cultural heritage, digitalisation, disrupted cultural continuity, controversial heritage, local communities

Abstract: In current literature heritage is perceived as providing a special sense of belonging, but also it reflects the complexities of how communities define and negotiate their identity, symbols and memory. Strategies for heritage preservation and safeguarding pertain simultaneously to the regulation and negotiation of the multiplicity of meaning in the past and to the mediation and arbitration of the cultural and social politics of identity and belonging. Engaging with intangible culture in heritage institutions raises the issue of participatory museology and evokes ideas of cultural inclusion and dialogue, but also hints a new exclusivity inherent of the power of self-representation, as groups that had historically been marginalized are now actively involved in museum work. However, the new role of local communities, as holders of intangible culture expressions, may be a difficult task considering the areas with disrupted cultural continuity. Based on a qualitative research conducted by the author in local communities in selected Polish cities (Warsaw, Cracow, Wroclaw) in 2016-2018 the presentation will address and discuss the dynamics of intangible cultural heritage digitalisation taking into account the local communities involvement in metropolitan areas with disrupted cultural continuity. The author will analyse cultural institutions' strategies for the visualisation of expressions of intangible cultural heritage considered 'controversial' or 'foreign' by the local communities. The analysis will start with a short theoretical introduction to the visualisation techniques and their role in the intangible culture heritage preservation, than the methodology used for the research will be problematized (Community-Based Participatory Research in the field of cultural studies) and the final findings from the study will be presented, with an emphasis on the new technologies' impact on the intangible cultural heritage initiatives and their potential as a mediator at local level for the identification and safeguarding of the controversial cultural heritage.

Relevance for the conference: The paper will discuss the new role of the digitalisation strategies in the intangible cultural heritage identification and presentation with regard to the local communities social and cultural empowerment and the potential of visualisation programmes in the processes of democratising the curation of artefacts in cultural institutions.

Relevance for the session: The presentation addresses the panel's topic by analysing new digitalisation strategies in selected Polish cities with disrupted cultural continuity aiming to involve the local communities in the identification and curation processes of intangible cultural heritage, which

revealed many areas of tensions between the local authorities and the communities' members over expression of the intangible culture considered to be 'controversial'/'foreign' by the communities.

Innovation: The presentation will investigate in an innovative way the new technologies' impact on the intangible cultural heritage initiatives as a platform for mediation at local level, giving voice to groups that had historically been marginalised in the museum work.

References:

- Whaley S., Cisneros R.K., Sabiescu A. (eds.) 2018. Digital Echoes: Spaces for Intangible and Performance-based Cultural Heritage. Cham: Palgrave Macmillan.
- Kapralski S. 2011. (Mis)representation of the Jewish Past in Poland's Memoryscapes: Nationalism, Religion, and Political Economies of Commemoration. In: E. Lehrer (ed.) Curating Difficult Knowledge. Violent Past in Public Spaces. NY: Palgrave Macmillan.

Elisa MIHO | Kristiana KUMI | Julia DEMIRAJ, Albania

The decommunization of the "Pyramid" in Tirana, the mausoleum of Enver Hoxha

Keywords: Unwanted Heritage; Socialism; Mausoleum; Albania; digital documentation;

Abstract: The communist regime that governed Albania during 1944-1991 has left considerable architectural remains that are now disappearing according to new urban developments. The project presented here will explore the perception of the monumental heritage of the socialist regime starting from the monument of "Piramida". For the first time in Albania, a futuristic and avant-garde architecture was built, too modern and too innovative for the time. Embedded in the urban context of Tirana, the function of this building was being the mausoleum for the Chairman of the Communist party "Enver Hoxha", a place of (obligatory) pilgrimage for the citizens of that time. It was designed in 1988 by the dictator's daughter Pranvera Hoxha, his son-in-law Klement Kolaneci, Pirro Vaso and Vladimir Bregu. This building is raised on platforms and stairs which create a square that looks like a pedestal holding for the Pyramid. According to its architects, the top view, goes in harmony with the shape of Mount Dajti. In the years that brought great socio-political changes, it was used as a cultural and social center that over the years has been much neglected and eventually has been transformed as a sort of place of "modern archaeology". For the new generation the "Piramida" is something that has always been there, a part of the affective geography, or a contextual horizon, both a foreground and a background in which people feel free to be themselves. From the point of view of the generation that has lived during socialism, the value of the heritage of the dictatorship was unavoidably connected to the memory of the time spent living during the regime. These features contribute to the production of a well-rounded image of the life under the regime in all its facets, and to a better comprehension of post-socialist societies.

Relevance for the conference: The project will present the untamed truth of the discontent of the people over the mausoleum at the beginning of the democracy, but eventually accepting it as a part of the nation's past.

Relevance for the session: The project will shed light over the pure reality of the socialist architecture in Albania.

Innovation: This project will be the first one to visualise the controversial heritage of the socialist architecture in Albania, for the international scene.

References:

- <https://web.archive.org/web/20140224113116/http://www.balkanweb.com/gazetav5/newsad/min/preview.php?id=55071>
- <http://revistas.jasarqueologia.es/index.php/APJournal/article/view/66>

Wolfgang NEUBAUER | Nikolaus STUDNICKA | Mario WALLNER | Hannes SCHIEL | Klaus LÖCKER
| Ralf TOTSCHNIG, Austria

Rosenburg – Rapid state-of-the-art 3D documentation and mapping of a mediaeval castle using TLS, ULS and GPR

Keywords: Laser Scanning, Rosenberg, Ground Penetrating Radar

Abstract: The detailed 3D documentation of mediaeval castles in heavily accessible topographic settings or partly hidden behind dense vegetation encounters major challenges to conventional topographic, geodetic or photogrammetric surveying. This paper presents a rapid solution for the detailed documentation of the upstanding architecture combining terrestrial and unmanned laser scanning (TLS/ULS) and motorized high resolution ground penetrating radar (GPR) for the detection and documentation of remains hidden in the subsurface. The large mediaeval castle Rosenberg, Lower Austria situated on a prominent mountain ridge provided a typical situation for a respective case study to present a state-of-the-art solution for quick and efficient surveying above and below the surface. The used terrestrial laser scanner RIEGL VZ-400i is able to perform hundreds of scans in one day, which can then be registered automatically. An RIEGL VUX-1UAV laser scanner system mounted on the multi-copter RiCOPTER was applied to measure the roof landscape in minutes and supplement the ground-based data acquisition. A motorized multi-antenna GPR system MIRA measures delivers additional information on subsurface remains like vaults, cisterns, walls of previous buildings up to the remains of garden layouts. We present the latest developments in data acquisition, processing and fusion of such 3D data sets for the documentation of historical buildings or archaeological sites with still standing architecture including the fast and efficient production of 2D maps and plans from the dense 3D data sets.

Relevance for the conference: state-of-the art combination of TLS, ALS and GPR

Relevance for the session: Digital documentation of historical buildings and archaeological sites

Innovation: Fusion of laser scanning and ground penetrating radar data

Give two references which match the topic of the abstract:

not applicable

Benno RIDDERHOF, The Netherlands

Beyond good and evil; why some controversial heritage always survives. The case of George Armstrong Custer

Keywords: controversial afterlife, heritage, historic perception

Abstract: 2026 is the 150th anniversary of the battle of the Little Big Horn where General Custer and his 7th cavalry were annihilated by the Sioux warriors led by Crazy Horse and Sitting Bull.

Today George Armstrong Custer is one of the most famous people of the old wild west, an icon of what it is to be an American. General Custer, Civil War hero, Indian fighter and all American hero,

immortalized in books and movies.

But Custer is also the butcher of the battle of the Washita. During this “battle” Custer and his 7th cavalry took all the wives and children hostage when they attacked the Cheyenne camp. Using them as shield he killed nearly all of the native American warriors. Custer tried to repeat this tactic at the Little Big Horn, but it backfired dramatically and he and almost all his soldiers lost their lives in the battle.

And that should have been the ignominious end of a failed soldier only fit for a little footnote in history. But the opposite happened. After his death Custer transformed into the icon of part of the American psyche. Numerous films and books haven been written about this man. Some praise him as a hero and some condemn him as a glory hunter, insane person and war criminal. But he never disappeared into obscurity.

In the 21st century a new generation is questioning the heroes of old. They are not heroes anymore but remnants of a mentality that was oppressive and wrong!

And yet there is one remarkable exception. George Armstrong Custer! Today the memory of him is more alive than ever. And far from describing him as a villain, today he is portrayed as the one true American, flawed but still worthy of our admiration. This presentation will explain why.

Relevance for the conference: Custer is visual heritage and controversial

Relevance for the session: Custer as a subject of controversial heritage explains why some subjects survive changing attitudes in society

Innovation: nobody talk about why object stay heritge even when they are controversial this one does

References:

- Isabel Vandervelde 2014 Custer Laughed James E. Mueller 2013 Shooting Arrows and Slinging Mud

Benno RIDDERHOF, The Netherlands

“I’ll make you an offer you can’t refuse” “I lost a son you lost a son” Lepidus’s survival a case for database research into Family politics and power during the second Triumvirate and the early Principate.

Keywords: database controversy powerstructures Principate

Abstract: The story of the fall of the Roman Republic is filled with larger than life individuals. Caesar, Crassus, Pompey, Antony/ Cleopatra and Augustus fill the pages of popular and scientific literature documentaries and movies. And when the fighting was over in 30 B.C. Augustus emerged as sole victor. All his predecessors and rivals died a violent death. The Fall of the Roman Republic is not unlike the mafia wars of the 20th century.

But wait, what about Marcus Aemilius Lepidus? Who? Marcus Aemilius Lepidus, part of the second triumvirate together with Antony and Augustus. He survived the fighting and remained the supreme high priest of the Roman world the Pontifex Maximus until his death in 12 BC.

But why was this opponent of Augustus allowed to live and perform the function of high priest.

Augustus was not squeamish about killing opponents. And Killing your opponents was a way of life in the Late Republic. Again not unlike the actions of the Boss of Bosses in the 20th century. Yet he let Lepidus live.

In order to understand the dynamics of the Late Republic we have to look beyond the individuals that are blurring the scene. Every prominent Roman politician has a backing consisting of the people depending on him and his family (La familia). This pattern resembles very clearly the pattern in Maffia families in the 20TH century, a very controversial idea.

Unfortunately, due to the incompleteness of the data, the disperses of the data and the huge amount of untapped indirect data no real research has been done in that direction.

Today all this information has been put into a database, allowing us to bring the “first families” into the limelight and explaining why Lepidus was not killed and why the basis of power in Rome was la Familia

Relevance for the conference: story of ancient rome is prime Heritage

Relevance for the session: Explaining the power structures in Rome using a database and compairing them with maffia organization is very controversial

Innovation: The database of the Roman families is a first it did not exist, allowing to develop studies, speculations, investigations, aimed to rethink and better analyse the period, with a linear or non-linear approach, something that can be helpful and capable to bring some new elements on the desk of the scholar

References:

- Weigel 2002 Lepidus the tarnished triumvir.
- Ridderhof 2018 The Roman family and the Maffia some remarks about similarity

Benno RIDDERHOF | Giorgio VERDIANI | Willem BEEEX, The Netherlands, Italy

The Good, The Bad and the Sexy; An Introduction into Controversial Heritage

Keywords: Heritage, controversy Popper, Kuhn

Abstract: We are living in interesting times as the old Chinese would say. Society is in a state of flux. Values are changing. Things we thought were fixed are now being contested and good turns bad and bad turns good or worse. And nowhere is this more visible than in the approach to heritage.

Yet heritage has not changed. The Rostrum of Albert Speer in Nuremberg is still the same and the skyscrapers of Mies van der Roohe have not suddenly turned into something nefarious.

What changes with every generation is not the description of heritage, but its intrinsic value. Intrinsic values changes with every generation; couple this with the uncertainty each new generation has you will have controversy.

Yet how do we the scientific community deal with this. Do we ignore it like art historians, do we go overboard like museum directors, or do we say nothing and go with the flow.

It is time for clarification into heritage and controversy. That is the aim of the session. In the opening presentation we will give an introduction into the subject. Using two to three examples the subject of controversial heritage is introduced with al its pitfalls but also with interesting insights.

Relevance for the conference: It's heritage and how we should scientifically approach it

Relevance for the session: In order to have a meaningfull discourse about controversial heritage you need to first define it.

Innovation: We are presenting a subject that is very important but has been ignored for too long

References:

- Fine 2001; *Difficult Reputations: Collective Memories of the Evil, Inept and Controversial*
- Allison 2018; *Controversial Monuments and Memorials. A guide for Community Leaders*

Maria Ines SCIOLLA, Argentina

La Candelaria, the Jesuit farming state: technological resources for its understanding within the World Heritage Site

Keywords: Jesuit Heritage - 3D modeling - virtual visit

Abstract: Application of new technologies for accessibility to Heritage

The Society of Jesus settled in Cordoba in May 1599. From there, the great Jesuit work began. Its contribution came to the creation of a University, the first in our territory.

The expansion of the Jesuits in the city and territory was immediate. Their mission was to take the Gospel to the most recondite places and that allowed them to know the territory, facilitating the selection of lands for the settlement of their eight estancias, one of them, La Candelaria, which were created to pursue and sustain its educational and missionary goals.

This situation led to the declaration of the whole as a World Heritage Site, in 2000, due to its high authenticity value.

The constructions of the estancias are unique buildings in their environment with a large technical deployment. But undoubtedly the ingenuity and ability of the authors to adapt European solutions to local environmental and technological conditions have produced works of great originality, in a rural environment of difficult accessibility, then and now in the case of La Candelaria. Located 130 km from the capital of the province, on the Sierras Grandes, half of the road has to be done by climbing unpaved roads.

The contribution of our work goes through the implementation of exact survey methods to supply accurate documentary evidence of this Estancia, and its reconstruction with 3D modeling techniques in sketch-up, Blender and the creation of a site that allows a virtual visit as augmented reality in Unity. The aim of this work is to take a work of very high patrimonial value and to make it accessible, since due to its rural location, the distance and road conditions it is no easy to reach.

Relevance for the conference: Documentation of the architectural ensemble allows its preservation and its accessibility to the scientific community and people in general.

Relevance for the session: Virtual access to a work of high patrimonial value which is difficult to reach.

Innovation: Innovation in the use of virtual reality programs based on scientific research

References:

- Survey and documentation for Heritage Preservation - Virtual tours

Mattia SULLINI, Italy

Modern iconoclasms and idolatries; 3D reconstruction as a chance to circumvent the impasse. The Ciano Mausoleum

Keywords: VR, 900, 3D, reconstruction, interactive

Abstract: In the research presented here, the effort of going behind a series of technical issues about Virtual Reality is focused on very controversial subject: the half-built and abandoned Ciano's Mausoleum in Livorno that despite dating less than 80 years, is indeed a modern "ruin". Its situation allowed to bypass any philological speculation and to focus the effort on survey, data-processing, cross-validation with project designs and virtual reconstruction. The Ciano Mausoleum reconstruction was not only chosen for such technical purposes since it is also significant at an epistemological level. Ciano was a popular WWI hero, an early participant to the National Fascist Party and one of its key leaders. He died in 1939, and the building of the Mausoleum had been most of all functional to Fascist. The building is still looming on the top of a hill. It is a relevant part of Livorno built heritage. Should it be treated as a valueless block of stone and concrete to be demolished, or as a neutral product of a precise historic period and preserved? By surveying its material consistence, digitalizing and comparing it with the original designs means not only to get to a reconstruction that is based on facts, or to obtain the well-known benefits of digitalized archaeological data in terms of accessibility and communicability, but also to bypass a cultural impasse. A virtual reconstruction indeed does not imply any kind of preliminary intervention on the artefact and resides on a far more manageable level than the one of physical interaction. Furthermore, since the 3D reconstruction is proposed in the form of an interactive videogame, the experience could easily be integrated with augmented content such as comments, didactic comments, or by any additional feature that could funnel the experience in any desired direction, preventing misuses or misinterpretations.

Relevance for the conference: Data are almost meaningless if they aren't accessible, and modern technologies such as personal/portable VR devices are an unprecedented chance to bring archaeological reconstructions to a wide audience

Relevance for the session: Digitalization and reconstruction can be a way to preserve any culturally neutral significance embedded in items that are symbols of recent problematic past.

Innovation: Interactive 3D reconstructions derivated from complex raw survey data greatly amplifies the reach of those data by improving user experiences, especially for the wide audience of profanes

References:

- "Virtual reality and archaeological reconstruction: be there, back then." MW17: MW 2017. Published February 14, 2017. Consulted July 10, 2018.
- Bakker: G. F. Meulenberg; J. de Rode 2003 "Truth and credibility as a double ambition: reconstruction of the built past, experiences and dilemmas." The Journal of Visualization and Computer Animation Volume 14, Issue 3 pp.159-167 John Wiley & Sons, Ltd.

Davide TANASI | Michael DECKER | Kaitlyn KINGSLAND | Rebekah MCLAUGHLIN, USA

3D Digitizing John Ringling's Wisconsin Train Car at the John and Mable Ringling Museum of Art in Sarasota, Florida

Keywords: 3d scanning, historical train, accessibility, 3d printing

Abstract: The John and Mable Ringling Museum in Sarasota, Florida is home to the private train car of John Ringling: the Wisconsin. This unique train car served as the home for John Ringling during his frequent journeys around the United States where he would book the circus and buy new acts and equipment. In order to preserve the train car for the future as well as assist curators in 3D printing new train car parts that may need replacing, the University of South Florida's Institute for Digital Exploration (USF IDEx), digitized the Wisconsin train car in the Spring of 2018, using terrestrial laser scanning (TLS) which is accurate up to less than a millimeter and took two days to perform 60 laser scans. The completed digital model was uploaded to the 3D model sharing website, Sketchfab, for dissemination to the public, providing access to the interior of the car which is currently closed to museum visitors. Individuals can view the Wisconsin in virtual reality both on the Sketchfab website as well as via other virtual reality softwares, allowing the exploration of the train car from anywhere in the world, while providing accuracy to researchers to explore and understand the Ringling's life and legacy. With technology that supports virtual reality becoming more common, individuals have increasing access to view and explore the Wisconsin as if they were present at the Ringling Museum.

Relevance for the conference: The subject of the contribution is a unique vehicle representing a piece of Florida history which is hardly accessible and digitally underrepresented.

Relevance for the session: Being a 1896 train car, the Wisconsin does not seem at first glance to deserve the status of Cultural Heritage, but its owner, John Ringling was certain a relevant historical figure for early America. The contribution will argue about the definition of Cultural Heritage in the case of the Wisconsin train car.

Innovation: The innovation relies in the design of a protocol for 3d digitization and global digital dissemination of historical vehicle

References:

- José Ignacio Rojas-Solaa, Eduardo de la Morena-de la Fuente, Digital 3D reconstruction of Betancourt's historical heritage: the dredging machine in the port of Kronstadt, *Virtual Archaeology Review*, 9(18): 44-56, 2018;
- Colson, Digital documentation of ships in cultural heritage: a European review, doi:10.5194/isprs-archives-XLII-2-W5-129-2017

Digital versus Analogue – Challenges and Benefits in Archaeological Reconstructions and Presentations in Exhibitions

Chairs: Karina GRÖMER | Carmen LÖW, Austria

Analog reconstructions and presentations of prehistoric artefacts, houses and the like have a long tradition. At latest since the beginning of the 20th century they are commonly goods in museums and other places to support cultural mediation. Lately exhibition makers take more and more advantages of the various possibilities offered by digital media. The number of archaeological apps increases almost daily and it becomes cheaper and cheaper to create augmented reality devices. At the same time it seems that digital tools, with their almost limitless possibilities, rarely have a solid theoretical background in terms of theories of professional cultural mediation. All too often, the mediation approach is a purely affirmative one, reducing the possibilities of the user to pure consumption. In addition it seems that the digital device is often given preference over its analogue counterpart because it looks more up to date and not because it is the better approach to achieve the mediation goal – which it undoubtedly is in many cases, but not in all.

We invite presenters to our session who want to share their own experiences with the both and show best and worst practice examples. We would like to hear more about to the underlying mediation approaches that led to the selection of the chosen tools. In addition presenters should discuss long term observations of analogue and digital reconstructions, e.g. in exhibitions, like additional costs, maintenance, usability and the interaction of visitors with the tools selected.

Karina GRÖMER | Anton KERN | Andreas KROH, Austria

Critical assessment of media in the permanent exhibition of the Natural History Museum

Vienna: Prehistory and Palaeontology

Keywords: exhibition, Natural History Museum Vienna, films, animations, 3D-projection

Abstract: Digital media and technical equipment both in temporal (special) and permanent exhibitions media illustrate and enable deeper insights into the content on display. For exhibition designers, it is a small line between useful media inserts and use of media that dominates the display over the original objects.

In the permanent exhibitions of the Natural History Museum Vienna media of different kind is in use: film clips about research activities, animations, virtual activities with Kinect® systems, 3D-projection, interactive stations, and a “virtual changing room”.

We examine the interaction between museum visitors and media: How are the installations used? What are people doing? How much time do they spend at the stations? Do different age groups of users react differently? Is there a difference between originally intended use and real use by the visitors?

Developing exhibition media is very time consuming and, therefore, expensive. The installations are developed at a specific point of time with using currently available techniques. Technical progress, however, is rapid. Specifically in the field of 3D animation, products age rapidly. Likewise, the media

stations themselves are aging and after a few years the software used may no longer be supported by the producers anymore and replacement for hardware, as well as skilled technicians may be difficult to come by. Intended lifespan of permanent exhibitions typically is 15 to 30 years. With few exceptions, media stations have a much shorter life cycle. In our experience IT hardware of media stations typically needs to be replaced every five to ten years and 3D animations tend appear old fashioned after ten years. This shorter life expectancy of media stations needs to be factored in when planning permanent exhibitions and both staff for maintenance as well as funds for replacement need to be set aside to guarantee long-term function.

Relevance for the conference: The CHNT-conference usually discusses the advantages of modern media – here a critical assessment of their use in long term perspectives is given on example of two permanent exhibitions at the Natural History Museum Vienna.

Relevance for the session: This contribution discusses media stations in the permanent exhibitions of Prehistory (2015) and Palaeontology (2001-2011) at the Natural History Museum Vienna in terms of a long term perspective: costs for maintaining, ageing of media, problems with functionality in “over-use” (groups of school children, thousands of visitors in Museums Night).

Innovation: Critical assessment of media stations in use at the NHMW showcases the importance of accounting for their shorter lifespan in contrast to traditional museum objects when planning permanent exhibitions.

References:

- Guide to the collections of the NHMW

Gernot HAUSAR, Austria

Digital first? Saving Digital Worlds, Artefacts and Inhabitants

Keywords: Digital Archaeology, Digital Humanities, Digital Sphere as Primary Source, Bridging the "Digital First" Divide

Abstract: While Digital Tools are widely used in the digital Sciences and Humanities, the "Digital" as a sphere where purely digital artefacts and the context and "worlds" they exist in need to be experienced, recorded, reconstructed and reactivated for posterity is a minority view. With the digital sphere more and more seen as a territory, where purely digital artefacts can be created and also be stolen - with real-life criminal law repercussions - the question of preservation of those artefacts is paramount for digital archaeology and history.

Even using bridging technologies like (3d-)printing, a digital artefact can seldom be recreated in a physical form that closely resembles the digital. These "digital first" objects can best be recreated in a digital environment.

It only gets more complex if we think about whole digital spheres like Web-portals, Social Networks or - even more complex - Massive Multiplayer Online Games. The recreation process needs the emulation of the necessary hardware, the server-side software and (emulation of) the input devices. It further needs all the historical user interaction data with each other and the software. Only then can an artefact be adequately recreated and researched.

So what is the digital sphere we want to preserve and what infrastructure is needed for preservation?

This talk offers basic observations on the need for a definition, showcases approaches taken in preservation efforts (including some hacks by the different actors) and offers some ideas for an European digital preservation effort.

See also: <https://digigeist.hypotheses.org/308>

Relevance for the conference: Bridging the divide between digital artefacts and "physical" archives is paramount to the preservation of the history and artefacts of the first digital years.

Relevance for the session: Digital vs Analogue will more and more be the question one has to ask if one tries to preserve digital artefacts - some of which might only be preserved if preservation is approached from the "right" direction.

Innovation: Overview of approaches for preservation that work - most of them sadly by scientists from other fields or citizen scientists.

References:

- Averett, Erin Walcek; Gordon, Jody Michael; Counts, Derek B. (2016): Mobilizing the past for a digital future. The potential of digital archaeology. Version 1.1 (updated November 5, 2016).
- Vogeler, Georg (2018): DHd 2018. Kritik der digitalen Vernunft : Konferenzabstracts : Universität zu Köln, 26. Februar bis 2. März 2018.

Carmen LOEW, Austria

UNESCO Pile Dwellings around the Alps - Cultural mediation between affirmation and deconstruction

Keywords: Cultural mediation, pile dwellings, exhibition,

Abstract: As a small entity with a big mission, the Kuratorium Pfahlbauten is breaking new ground in cultural mediation in Austria. Funded for the management, communication and mediation of the UNESCO World Heritage "Prehistoric Pile Dwellings around the Alps", the organization finds itself confronted with the obligation to integrate an invisible world heritage into people's daily lives. The UNESCO World Heritage Convention requires an active participation of the broad public in the World Heritage, which can not be achieved with the classical affirmative mediation approach, which seeks confirmation only. In considering theories of contemporary cultural mediation the Kuratorium explores new ways, for example, in showing exhibitions in the sense of a reproductive discourse specifically in public places where they are not necessarily expected or in streaming live from an underwater excavation in the internet. Public is involved in choosing the topics of exhibition topics and supplements and to prepare the content of the exhibitions for mediation, but is also asked to give an immediate feedback and share positive as well as negative experiences with the topic of pile dwellings. The presentation will discuss two of the current exhibitions. It will investigate the question for which mediation goals digital or analog tools have been chosen and why. I will also discuss in what cases digital or analogue tools have been expected by the public as well as the answering the question what advantages and disadvantages in the use of the exhibition resulted from the chosen tools.

Elisabeth MONAMY, Austria

Digital: analogue. The dilemma

Keywords: mediation, technologies, analogue systems, presentation

Abstract: Our everyday life has become extremely digital. Wherever you go and travel, the first thing to check is the free WIFI! One can do everything online with his digital device. Accordingly, it is very obvious that the presentations in museums (permanent or special exhibitions) or archaeological sites are digitized. Museum applications or applications with historical or archaeological knowledge and background grow like mushrooms. Every day there are new, innovative and increasingly affordable digital ways to pass on knowledge and awareness for the past, let's just name two of them: virtual and augmented reality. The question nevertheless arises whether this digitization makes sense and is accessible to everyone. Are not groups excluded by this massive digitization? Furthermore, digital presentations are mostly just a digital copy of a poster or statement in a museum, or worse, excerpts from web pages. On the other hand, have museums with exclusively analogous exhibitions become bland and unattractive? Already in the 1950ies and 1960ies, André Malraux, the French novelist and Minister of Cultural Affairs concluded that art allowed men to connect with past times and therefore worked hard to preserve France's heritage. His ideas published in "The museum without walls" are surely out-dated nowadays or to be seen as a thought-provoking impulse. Interestingly, for him heritage is not transmitted but conquered! May be Malraux was a mastermind and with our technologies we should make heritage accessible for everyone. In this lecture, the author will present some advantages and disadvantages of digital and analogue presentation and cultural mediation through recently experienced examples in museums and archaeological sites in Europe and the Near East. Visually and interactively, the talk will show that only the combination of both variants (digital and analogue) gives any visitor or viewer the opportunity to get a complete, comprehensive and adequate overview of the museum, exhibition or site.

Relevance for the conference: This paper will show different aspects of cultural heritage mediation with digital technologies and analogue possibilities.

Relevance for the session: Brief summary of advantages and disadvantages and even problems with digital and analogue presentation methods

Innovation: Failures and successful mediation will be presented.

Üftade MUŞKARA, Turkey

Industrial Heritage and Augmented Reality Applications

Keywords: industrial heritage, SEKA Paper Museum, augmented reality

Abstract: Industrial heritage today is being taken even more seriously by academic scholarship. It is due to the instituting of heritage studies across humanities, social sciences and natural sciences and developments in contemporary archaeology. Industrial heritage is broadly defined by many specialists after Nizhny Tagil Charter (2003) as consisting of "the remains of industrial culture which are of historical, technological, social, architectural or scientific value". Industrial sites such as the early production units and factories in Turkey are generally abandoned and forgotten; only a few of them however were preserved and museumized. Meantime, industrial heritage comprises more than just material culture, but also valuable intangible forms of heritage. In the case of factories as the products

of early industrial developments in Turkish Republic during 20's and 50's, they provide us important insights about the structural alteration in culture and social life in the region. Lives in factories and their campus areas were the representation of transforming identities of young republic. Therefore, preserving and conserving of such sites should consider not just the building itself but tangible and intangible heritages values together. Temporal layers including the time when the factory was still active, when it was abandoned and spatial layers including living and working quarters of industrial sites should be equally transmitted to various targets groups. Probably the best way to accomplish this is using augmented reality applications. This project considers how augmented reality contributes to perception of visitors with maintaining cultural mediation in SEKA Paper Museum situated former pulp and paper mill in Kocaeli district. It also suggests that cultural heritage specialist today should participate more in such studies in order to design accurate substructure, interface and content.

Relevance for the conference: The project is about new media applications in industrial heritage sites

Relevance for the session: The project considers theoretical frameworks of digital applications on heritage values and their perception by users.

Innovation: the corporation of the experts on the fields of cultural heritage, photography, art and computer technology and consideration of industrial heritages sites from a wider perspective in Turkey

References:

- The Cambridge companion to historical archaeology (Dan Hicks and Mary C. Beaudry, 2006)
- Interdisciplinary Cooperation in the Virtual Presentation of Industrial Heritage Development (Vladimír Hain Robert Löffler ViliamZajíček, 2016)

María-Eugenia POLO | M^a DE LOS REYES DE SOTO | Guadalupe DURÁN-DOMÍNGUEZ | Carlos J. MORÁN, Spain

Proposal of virtual documentation and dissemination of the information of the archaeological object

Keywords: Virtual documentation, Archaeological context, Archaeological database

Abstract: Is it possible to make the general public understand the archaeological objects using only one virtual tool? The use of knowledge network helps us to disseminate the content and allows the access to the creation and the distribution of other typology of image which were previously restricted to a just few people. In this way, we replace the analog image of the material heritage with its digital version, assuming that it is the best approach to achieve a more comprehensive dissemination of information, without asking ourselves if we have marginalized the archaeological context. In general, we use virtual technology to surprise, without really reflecting on understanding the object, with all its historical memory. The purpose of this approach is to compare these working methods from both analog and virtual points of view considering some problems such as the cost of modelling, the expenditure of time or the need of an expert user to manage the virtual tools. One of the most important aspect of this approach will be to analyse what we contribute regarding the purely analog approach or to assess if these digital tools distract us from the historical understanding of the object. For this reason, the virtual documentation will include all interactive information of the object, managed

from a wiki (using Wikidot - <http://www.wikidot.com/> -), including bibliography, links to archaeological database, high resolution photography (shown in -<https://www.flickr.com/>-) and 3D models of the archaeological objects obtained from both 3D scanner and digital photography by means of the Image-Based Modelling system (shown in - <https://sketchfab.com/> -). In conclusion, we consider that the traditional analog information of these objects can and should be included in this virtual proposal. Some questions should be answered as why these tools have been chosen, what the scope of these tools is, and how many objects can be presented in this way when the process of generating 3D models become computational routine.

Relevance for the conference: We propose a set of tools for virtual documentation and dissemination of the information of the archaeological object taking into account the traditional analog information of the object.

Relevance for the session: We propose to use virtual tools and networks to integrate the analog and virtual perspectives of the archaeological object.

Innovation: Using wikidot, 3D scanning, image-based modelling, database, Sketchfab and Flickr to document the archaeological object including the historical understanding of the object.

Reference:

- Polo M. E., Vaquero J. M., Felicísimo A. M. 2017. Metric Properties of Sundials using 3-D Models from Digital Photography. *Historical Archaeology* 51 (4) 557-562.
<https://sketchfab.com/secad/collections>

From analogue death to digital re-birth – reconstructing written heritage

Chairs: Katharina KASKA, Austria

Throughout history books and documents risked being destroyed either by accident or on purpose. Not all of them were completely lost, however, some survived in a mutilated and damaged state, shriveled and darkened from heat, made illegible by water or torn to pieces by physical force. For centuries researchers have been trying to reconstruct those remnants using ever evolving methods to extract information and present their results to the public.

The arrival of digital imaging techniques and online databases was a major step forward not only in quality but also in quantity of reconstructed written material available for research. Text can now be extracted from damaged documents by new optical and spectroscopic methods, fragmented objects can be put together in a virtual environment and all results can be made available in an instant on new online platforms. This leads to a renewed interest in written material that had before been deemed too fragmented or too dispersed to be researched in any depth. This session therefore focuses on the application of new and improved methods for the reconstruction of written heritage and their presentation in online environments. It invites papers on technical aspects as well as case studies that highlight the application of new techniques within fields such as:

- Digital reconstruction of fragmented documents

- Databases for fragmented and reconstructed written heritage
- New forms of online collaboration for dispersed written material
- Advances in multispectral imaging of erased and degraded script
- Image processing techniques for heavily degraded or multilayer documents
- XRF-mapping for text recovery

Andreas BLÄCKER, Germany

New multispectral scanning method for Drawings, Paintings and Manuscripts

Keywords: Multispectral scanning analysis, material structures layers and watermarks; palimpsest;

Abstract: Book2net has developed a novel method for multispectral analysis of documents and drawings.

General

The development of an innovative technology for multispectral analysis in the range of 300 - 1300 nm was the task of our research project. At definable nm intervals, individual or series of scans can be performed. The scan results can be superimposed pixel by pixel and analyzed. The book2net method works without filter change (vibration-free) and without post-correction of sharpness and focus in the spectral ranges (pixel scale accurate). Pixel-accurate overlay, division, subtraction, and addition techniques can be applied to this database for image analysis and visualization of the desired information.

A systematic standardization of the scanning, light and imaging processes as well as deposition of profile structures enables comparability and repeatability. Profile structures allow the formation of classes or analysis groups.

Case Study:

Multispectral analysis of the LUCRETIA (Lucas Cranach the Elder)*

The study shows the whole range of multispectral analysis from UV up to IR range.

Underdrawing, hatching, auxiliary lines, fabrics, watermarks, signatures, pentimenti, signatures, inscriptions and marks can be analyzed in the different multispectral segments.

The study gives the answer. Is the analyzed LUCRETIA an original drawing from Lucas Cranach the Elder?

*Klassik Stiftung Weimar, Graphische Sammlungen

Relevance for the conference: Multispectral analysis, material structures layers and watermarks; palimpsest;

Relevance for the session: New Multispectral technology

Innovation: New multispectral scanning method and image analysing method

References:

- Anna Amalia Library Weimar, fire and water damage;
- Lucretia, Klassik Stiftung Weimar

Simon BRENNER | Bernadette FRÜHMANN | Willi VETTER | Federica CAPPÀ | Manfred SCHREINER | Heinz MIKLAS | Robert SABLATNIG, Austria

Towards a unified Database for Multispectral Images and Spectroscopic Material Analysis of Manuscripts

Keywords: multispectral imaging spectroscopy database

Abstract: The research groups INTK (Academy of Fine Arts Vienna) and CVL (TU Wien) have a long history of collaborative work on historic manuscript analysis. While CVL is concerned with Multispectral Imaging (MSI) and document analysis, INTK performs non-invasive material analysis by combining complementary spectroscopy methods.

In the course of four joint projects conducted during the last ten years, around 100 manuscripts were examined. For half of them, both multispectral imagery and spectroscopic data were collected. Until now, the analysis of the acquired data was performed in large part independently by the respective groups. Now we are at a point where enough data for systematic analysis of the previously examined manuscripts is possible. This, however, requires a thoroughly structured database.

We will present our attempts to create a unified database containing imagery, measured spectra and detected pigments as well as metadata about both the investigated object itself and the technical methods that have been applied. Such a database will support the following applications:

Retrieval. Documents can be queried for similar properties derived from MSI or spectroscopy. This allows to study manuscripts on a meta-level and find possible connections between different manuscripts.

Machine learning. Finding correlations between MSI and spectroscopic measurements could help to establish rules for the discrimination of certain similar pigments from multispectral data alone.

Furthermore, the application of machine learning to the determination of pigments from spectroscopic measurements, which is currently performed by experienced experts, will be evaluated.

Interactive visualization. Point measurements can be visualized on top of multispectral images, along with spectral curves and detected materials, providing a more intuitive interface to the data. Further, using correlations between MSI and spectroscopy as mentioned in the previous paragraph, point measurements can be extrapolated across larger domains, thus producing approximate element maps without the need to perform a spectroscopic scan.

Ivana DOBCHEVA | Veronika WÖBER, Austria

Reconstructing the Fragmented Library of Mondsee Abbey

Keywords: digitalisation, fragments, manuscripts, bookbinding

Abstract: The Benedictine monastery of Mondsee was an important local centre for book production in Upper Austria already shortly after its foundation in 748. Especially important for the book collection were the monastic reform movements, which prompted the production of new liturgical books and consequently the discarding of older ones. When a book-binding workshop was installed in the 15th century many of these older manuscripts, regarded as useless, were cut up and re-used as binding waste for new manuscripts, incunabula or archival materials.

The aim of our two-year project funded by the Austrian Academy of Science (Go Digital 2.0) is to bring the fragments kept today in the Austrian National Library, the State Library and Archive of Upper

Austria in one virtual collection.

In this talk we would like to discuss some of the technical challenges we encountered by the digitalisation and processing, such as the work with small fragments partially hidden within the bookbinding, sewed in the middle of quires, or palimpsest leaves. Thanks to new tools and digital techniques we are able to visually document the fragments without detaching them from their host volumes. We will also address some disadvantages of digital facsimiles, namely the loss of information about the materiality of physical objects, and what steps we have undertaken to compensate for it through digital reconstructions and description of the fragments. In doing so we keep in mind the needs of a wide group of researchers from the fields of philology, codicology, history of the book and the bookbinding.

William DUBA, Switzerland

Digital Humanities meets Visual Heritage: the Birth of Fragmentology

Keywords: fragments, medieval manuscripts, interoperability, open science

Abstract: Three technologies have revolutionized scholarly approaches to visual heritage: digital imaging, online databases, and the interoperability paradigm. These technologies have had an impact on how scholars in the humanities do their research, and in the most dramatic cases, have opened entire new fields for investigation. Such is the case with the study of medieval manuscript fragments. Scattered around the world and hidden in boxes and books, fragments suffer from an at-risk existence. Unlike manuscript books, they offer only a few pages of the text that they carry and they usually begin and end in the middle; thus, individually, they require more time and produce less rewards than their complete counterparts. Digitization has made it possible to study these fragments systematically. Online databases have dramatically reduced the labor required to identify and describe fragments. The interoperability paradigm, that is, the orientation of research and resources towards collaborative use and reuse, can provide the catalyst. The Swiss National Science Foundation research project, Fragmentarium, has shown how to bring these three technologies together so that a constellation of scholars and research projects around the world can collaboratively produce a new field of research, Fragmentology.

Relevance for the conference: The proposed communication shows how the new, interoperable approaches to visual heritage have been harnessed to assemble an international team and build a new discipline in manuscript studies.

Relevance for the session: The paper provides a case study in building a virtual environment to bring together fragmented written material along with the researchers needed to study them.

Innovation: Fragmentarium does not just build for interoperability; it builds upon it.

References:

- <http://fragmentarium.ms> <http://e-codices.ch>

Roger EASTON | Chet VAN DUZER | Kevin SACCA, USA

Processing methods to recover text information from multispectral imagery of the world map by Henricus Martellus (c. 1491)

Keywords: Martellus Map, multispectral imaging, image processing

Abstract: The c. 1491 world map by Henricus Martellus Germanus, in the collection of the Beinecke Rare Book and Manuscript Library of Yale University, is a very important visual and historical object, being very similar to the c. 1492 globe by Martin Behaim and having significantly influenced the 1507 world map by Martin Waldseemüller. Martellus' map is painted on paper sheets mounted on canvas and most of the area is covered with text, nearly all of which has faded to the point where it is not readable to the unaided eye. Because of this condition, the map had been little studied, even though it had the promise of yielding significant insight about the geographical knowledge of the time.

The Martellus map was imaged by a team of scientists and scholars in August 2014. Though significant information was recovered during the imaging session, the subsequent spectral image processing required more than a year. Because of the different colors used for both texts and backgrounds (to represent different types of physical features), customized processing methods were necessary to recover many of the writings. From the results, it is estimated that more than 80% of the writings have now been recovered, vs. less than 10% available to the eye from the original map. This paper will review the processing methods used to recover the texts, including discussions of necessary preprocessing methods to balance the contrast of the text and background, useful segmentation algorithms, as well as postprocessing methods used to enhance the text visibility further.

Relevance for the conference: The variation in coloration of text and background meant that the multispectral image processing had to be customized for individual text blocks.

Relevance for the session: The project successfully recovered most of the text from this little-studied, yet historically significant, object.

Innovation: Text recovery required customized processing to recover texts with very different color contrast.

References:

- Easton, R.L., Jr., W.A. Christens-Barry, and K.T. Knox, Imaging and Image-Processing Techniques, Chapter 5 in *The Archimedes Palimpsest, Volume I, Catalogue and Commentary*, pp. 175-207, Cambridge University Press, 2011.
- Roger L. Easton, Jr. and David Kelbe, Statistical Processing of Spectral Imagery to Recover Writings from Erased or Damaged Manuscripts, *Manuscript Cultures*, V. 7, pp. 35-46, 2014.

Leif GLASER | Ivan SHEVCHUK | Daniel DECKERS | Martin TOLKIEHN | Ira RABIN | Oliver HAHN, Germany

Improving Iron Gall Ink X-ray Fluorescence element mapping

Keywords: Iron Gal Ink, XRF, statistical analysis

Abstract:

Preparing parchment for reuse is often based on a first step of chemical erasure of the previous text, resulting mainly in a removal of the organic compounds of the iron gall ink. This way the metallic part of the ink remains in the parchment at its original place of writing. Therefore it allows nowadays to use

non destructive X-Ray Fluorescence (XRF) investigations to access the original ink for local metallic fingerprint analysis and text recovery by mapping the object.

Especially in order to re-access the erased iron gall ink text non destructive modern techniques often very successfully apply different methods of optical full field techniques such as Ultra-violet and Multispectral imaging. The use of XRF complements these methods allowing an element specific probing of the writing, even if this writing is physically covered or otherwise optically inaccessible. This paper describes the XRF mapping technique as well as ways to improve the data treatment in order to minimize the analysis time. Thus in situ visualization of the measured areas is possible, applying statistical processing in addition to the classical XRF data treatment. The new approach is showcased and optional post processing steps shown that in some cases can significantly improve the contrast of the revisualized writing.

Relevance for the conference: XRF mapping is a versatile non destructive method to revisualize faded or erased Iron Gall Ink writing or paint - important tool in the scope of the conference.

Relevance for the session: The method described in the paper actually does exactly what the session title promises.

Innovation: The data treatment is accelerated from post processing to in situ visualization, as well as the post processing itself.

References:

- Glaser, L. and Deckers, D., Basics of fast scanning XRF element mapping for iron gall ink palimpsests, Manuscript Cultures No. 7(2014), ISSN 1867-9617, pp.104-112
- Cohen, Z. et al., (2015), Composition of primary inks in medieval palimpsests – effects of ink removal, OPUSCULA MUSEALIA 23, doi 10.4467/20843852.OM.15.007.5385 s. 75-82

Jana GRUSKOVÁ, Austria

15 years of digital recovery of the Vienna Greek palimpsests

Keywords: "Greek palimpsests" "Vienna manuscripts" "digital recovery"

Abstract: While the research on Greek palimpsests in the Austrian National Library started already more than hundred years ago with using ultraviolet light and ultraviolet photography, and culminated for the first time in the 1960s to 1990s, during the compilation of the modern catalogue by Herbert Hunger and Otto Kresten, who reached outstanding results in this respect, many important texts could only be revealed and studied in the past 15 years thanks to advantages of digital recovery of erased writings. Since 2001 several projects have been conducted at the Austrian Academy of Sciences (Division of Byzantine Research) in international cooperation with leading scholars in pertinent fields, focusing on deciphering, editing and examining the important Ancient Greek and Byzantine texts hidden as palimpsests under later writings as well as on an in-depth palaeographical and codicological analysis of the manuscripts themselves. Multispectral imaging and special image processing by several scientific teams have enabled the scholars to read and study texts that had hitherto been invisible: Early Manuscripts Electronic Library (EMEL, California), Technische Universität Wien (lately within the Project CIMA), and Fotoscintifica (Parma, Italy). In addition, X-ray fluorescence imaging was performed on problematic areas of one palimpsest (containing a newly discovered unique historical text from the 3rd cent. AD) in cooperation with the Deutsches Elektronen-Synchrotron DESY

(Hamburg) and the German Bundesanstalt für Materialforschung und -prüfung (BAM, Berlin). This talk focuses on the advances of the digital recovery of erased writings for the scholarly research and the lessons learned in the past 15 years, using examples from the important collection of Greek palimpsests in the Austrian National Library.

Keith KNOX, USA

Recovery of Lost Text: What the Scholars and Scientists Learn from Collaboration

Keywords: recovery, multispectral, imaging, collaboration

Abstract: To recover erased or damaged text, written on parchment, it takes a close collaboration between the scholar, that wants to read the text, and the imaging scientist, that is imaging the manuscript. In many cases, the characters are so indistinct, that only hints of them remain. It is only by the scientist and scholar working closely together in the recovery process that the full text can be obtained.

The recovery process starts with imaging the manuscript with a system that captures the response of the parchment and inks under illuminations ranging from the ultraviolet through the near infrared. Light with wavelengths from 365 to 1050 nanometers is used to match the sensitivity of the silicon sensor.

After the capture of the data, the recovery process begins. Sometimes, the desired text appears clearly in one or more of the spectral images. In most cases, the desired text shows up only faintly, and is partially spread over several of the images. Recovery of that text requires specialized manipulation of images across the collection to reverse the distortions and reveal the text.

It is in the recovery process where the major collaboration between the scholar and the scientist occurs. The scholar needs to help the scientist see the nature of the remnants of the desired characters. Without this, the scientist cannot tell when a process is working. At the same time, the scientist needs to illustrate to the scholar the types of results that processing can achieve. Because the nature of the distortions can vary across a single page, more than one processed result may be needed to recover the full page.

Examples from collaborative projects over the last few years will be used to illustrate the nature and importance of a close collaboration between the scholar and the scientist in text recovery.

Relevance for the conference: Recovery of erased or damaged text is a crucial element of the preservation of cultural heritage.

Relevance for the session: Collaboration between scholars and scientists is essential for the recovery of erased, damaged, or overwritten text.

Innovation: Several new methods of text recovery will be shown that have been developed through collaboration of scholars and scientists.

Michael PHELPS | Damianos KASOTAKIS, USA

The Sinai Palimpsests Project: recovering texts erased 1,000 years ago through the systematic application of non-destructive spectral imaging techniques

Keywords: spectral imaging, palimpsest, workflow, image processing, IIF

Abstract: The Sinai Palimpsests Project, a collaboration of St. Catherine's Monastery of the Sinai, Egypt, and the Early Manuscripts Electronic Library (EMEL), is the most extensive application to date

of spectral imaging to recover obscured information from historical source materials. Over its five-year course, the project spectrally imaged more than 6,800 palimpsest pages, generated multiple innovations, and managed a successful workflow including scientists, technicians and scholars on three continents. This talk will review the history of the project, its structure and procedures, selected contributions, and future directions.

This project was the first systematic effort to spectrally image a large and diverse collection of palimpsests. Notably, when spectrally imaging a manuscript collection of such volume, most of the effort goes largely unnoticed: cataloging, materials handling, data management, and quality control. All of these considerations defined the day-to-day operations of the project, in order to ensure consistently high-quality data across five years of imaging. The project team accumulated unparalleled experience in implementation of an end-to-end spectral imaging workflow. Protocols and procedures were established that suggest best practices for other spectral imaging programs.

Project results are now online, hosted by the UCLA Library in collaboration with the Monastery. For this purpose, UCLA developed a unique branch to Mirador (IIIF compliant) that supports the comparison of multiple images of the same folio, either side-by-side or in layers.

Relevance for the conference: The Sinai Palimpsests Project is the largest effort to date to use spectral imaging to recover obscured or illegible information from cultural heritage materials, and as such produced technical innovations and workflow optimizations for adoption by other projects.

Relevance for the session: The Sinai Palimpsests Project offers an exemplar for technical innovation, workflow optimization, and the IIIF-compliant publication (Mirador) of 80,000 images of previously unstudied erased text.

Innovation: The Sinai Palimpsests Project built a customized end-to-end workflow for a large-scale, text-recovery project, which included onsite spectral imaging, offsite data management and image processing, scholarly description, and online publication.

Ira RABIN | Oliver HAHN, Germany

Why do we need to study inks?

Keywords: carbon inks, iron-gall inks, mixed inks, medieval manuscripts

Abstract: While studying the socio-geographic history of inks, division 4.5 (Kunst- und Kulturgutanalyse) of the BAM (Bundesanstalt für Materialforschung und -prüfung) in Berlin together with the Centre for the Study of Manuscript Cultures in Hamburg has developed a protocol for ink analysis. It consists of a primary screening to determine the type of the ink, and a subsequent in-depth analysis using several spectroscopic techniques.

Using this protocol we can assist scholars in addressing a rather broad range of historical questions that can't be answered unequivocally through scholarly research alone. Among these are investigations on collaboration between scribes and scriptoria, on the usage and annotation of manuscripts and on their path through time and space in general. Our research can thus help to reconstruct the circumstances of the production of written heritage as well as their history and transmission.

In this presentation we will demonstrate the use of our protocol for the reconstruction of the history of the Codex Germanicus 6 from the Hamburg State and University library, an important 15th century

manuscript transmitting among other texts Wolfram von Eschenbach's epic Parzival.

We will also offer a brief report on the recent work conducted on parchment manuscripts in the Austrian National Library.

Relevance for the session: Knowledge of the ink type and composition helps to compare, reconstruct and connect manuscripts

References:

- Cohen Z., Kindzorra E., Hahn O., Glaser L., Łojewski T., Rabin I., Composition of the primary inks in medieval palimpsests – effects of ink removal ,*Opuscula Musealia* 23 (2015) 75-82; I. Rabin (2017), Building a Bridge from the Dead Sea Scrolls

Claudia RÖMER, Austria

Determining the origin of some marginal notes of ms. ÖNB H.O. 42a through ink analysis

Keywords: Ottoman manuscripts, Muşţafâ Bostân, Hammer-Purgstall, ink analysis

Abstract: Cod. ÖNB H.O. 42a is a copy of Muşţafâ Bostân's (1498-1569) Süleymännâme on the earlier part of the reign of Süleymân the Magnificent (1520-1566). Earlier scholars believed that its author was called Ferdî. This assumption is based on the alleged occurrence of this pen-name in the author's Persian poem (fol. 6r). Yurdaydın proved that the last verse of this poem had been misunderstood and the author of Süleymännâme was Bostân (Hüseyin G. Yurdaydın, Bostân'ın Süleymännâmesi (Ferdî'ye atfedilen eser), *Belleten* 19/74 (1955): 137-202).

The title in red ink (fol. 1r) says mü'ellifi Ferdî "Its author is Ferdî". In the margin of fol. 6 r next to the above-mentioned poem, there is a remark in black ink formulated perhaps by a non-first-language speaker (şâhib mü'ellif Ferdî ile taḥalluş éder "the owner author/the Lord author gives his pen-name as Ferdî"). The handwriting of both remarks possibly is European.

In order to determine whether this is true, an analysis of the ink of the manuscript versus the ink of the remarks would be helpful. As a first step, both remarks as well as a piece of normal text were photographed with a UV, VIS, NIR Microscope provided by Sebastian Bosch of the University of Hamburg (<https://www.manuscript-cultures.uni-hamburg.de/kontakt.html>) under visible light, UV, and NIR wavelengths . The red ink on fol. 1r vanishes under NIR light, whereas the black inks on fol. 6r and the ink used for Hammer-Purgstall's oriental seal (the ms. originally belonged to him) are visible in all three photographs. Thus, the original question will only be solved with a more detailed analysis of the inks by X-Ray Fluorescence (XRF), Fourier Transform Infra Red Spectroscopy (FTIR) and/or Raman Spectroscopy.

Relevance for the conference: Ink analysis helps finding out about manuscript owners and the marginal notes they added to the texts...

Relevance for the session: Being able to determine an author of a marginal note to a text prevents a detail of its history from staying obscure.

Innovation: Finding out the origin of the inks used (Oriental vs. European) may help solve the linguistic riddle of a misleading marginal note by an author hitherto unknown.

References:

- Römer, Claudia: "The Language and Prose Style of Bostan's Süleymanname", in: Humanism, Culture, and Language in the Near East. Studies in Honor of Georg Krotkoff, ed. by Asma Afsaruddin and A.H. Mathias Zahniser, Eisenbrauns, 1997, 401-418;
- https://www.manuscript-cultures.uni-hamburg.de/Poster/Z02_A4_P2.pdf .

Manfred SCHREINER | Bernadette FRÜHMANN | Wikfried VETTER | Federica CAPPÀ, Austria

The Visualization of Under-texts and Under-paintings in Written Heritage by Their Chemical Compositions

Keywords: Manuscript, Palimpsest, Chemical analysis, Imaging

Abstract: In the last decades a particular collaboration between historical, philological and cultural studies on one side and natural sciences on the other side has been developed and a close co-operation between e.g. art history, archaeology or conservation-restoration with physics, chemistry or biology seems fairly well established. The traditional documentation and investigation of works of art have been mainly performed by the application of photographic techniques using electromagnetic radiations using not only visible but also infrared, UV and X-ray radiations of the electromagnetic spectrum. In recent years, so called non-destructive analytical methods such as X-ray fluorescence analysis (XRF), Fourier Transform Infrared (FTIR) and Raman spectroscopy have been applied in order to visualise concepts of an artist (underdrawings) as well as the original structure of an art work, which could have been changed during conservation-restoration work in the past.

In the presentation the present state, development and perspective of these analytical tools will be discussed and case studies presented, carried out on paintings, polychromed sculptures as well as graphic art works and historic manuscripts of Austrian museums and libraries. Furthermore, the Centre of Image and Material Analysis in Cultural Heritage (CIMA) will be introduced, which could be founded in 2014 within the HRSM-project of the Ministry of Science, Research and Economy. It is an inter-university research institute of the University of Vienna, the Technische Universität and the Academy of Fine Arts Vienna focusing on these new techniques.

Relevance for the conference: Elemental mapping of under-text and under-paintings increases the information for philological studies of manuscripts.

Relevance for the session: The visualization of the over- and under-text in palimpsests as well as the under-painting can be essential for the authenticity of a manuscript.

Innovation: The combination of elemental and compound specific imaging is a non-destructive technique, which can be carried out in museums, libraries or other collections.

References:

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http://www.chemistryviews.org/details/ezone/9610631/Identification_and_Preservation_of_Cultural_Heritage.html
- K. Janssens, R. Van Grieken: Non-destructive microanalysis of cultural heritage materials. Elsevier (2004), Amsterdam

Ivan SHEVCHUK| Christian BROCKMANN, Germany

Resurrecting Lost and Erased Writing with Multispectral Imaging

Keywords: Multispectral Imaging, Recovery of Lost Writing, Spectral Reflectance, Non-Destructive

Abstract: Multispectral Imaging (MSI) has established itself as a versatile optical and non-destructive full-field imaging technique for the recovery of damaged or erased writing in manuscripts and especially palimpsests. In this talk, the method and the Hamburg Multispectral Imaging System will be briefly introduced with its possibilities and limitations and its role in respect to other complementary material analysis methods such as XRF, Raman and FTIR. Also, aspects of spectral image acquiring that ensure highest image quality and especially the advanced methods of data analysis, which is an essential step in the workflow of recovering of lost writing, will be described.

Among presented improvements of Hamburg Multispectral Imaging System such as new LED light sources, camera control software and long term data storage solutions - there are also new calibration and workflow routines. Performed tests have confirmed that these recent upgrades of the system have overall led to significantly better results and helped to improve the readability of otherwise unreadable text enabling the scholars to work with higher quality data.

Selected projects will be presented to highlight the versatile abilities of Multispectral Imaging not only in recovery of lost writing in iron gall, carbon or plant inks, but also, for example, uncovering different layers of paintings and drawings on paper, parchment and even palm leaves, and even in providing preliminary results for other complementary techniques such as X-Ray Fluorescence Element Mapping.

An outlook for future improvements of the system towards next phase of the CSMC and the new generation of Multispectral Imaging Systems will round up this talk.

Relevance for the conference: With Multispectral imaging it is possible to reconstruct and recover lost writing

Relevance for the session: Multispectral Imaging can resurrect lost and erased writing

Innovation: Technical improvements in data acquisition and analysis

References:

- Easton, R. L. Jr., Knox, K. T., Christens-Barry, W. A., Boydston, K., Toth, M. B., Emery, D., Noel, W. (2010), 'Standardized system for multispectral imaging of palimpsests', Proceedings of SPIE, 7531-12
- Janke, A.; MacDonald, C; 'Multispectral Imaging of the San Lorenzo Palimpsest (Florence, Archivio del Capitolo di San Lorenzo, Ms 2211)', Manuscript Cultures 7 113-24 (2014)

Geographic Information Systems (GIS) as Platforms of Method and Theory

Chairs: Benjamin DUCKE | Irmela HERZOG, Germany

Since the late 1980s, Geographic Information Systems (GIS) have played an exceptional role in data management, applied research and even the formation of spatial theory in a vast number of academic and professional fields, including (Physical and Human) Geography, Archaeology, Sociology and History.

Powerful and pervasive, GIS have dominated the discourse on spatial theory and methods for decades, with research areas such as visibility/perception studies (viewsheds), landscape use studies (least cost paths, territorial analysis) and space syntax evolving with and around them. Entire research subjects such as “landscape archaeology” seem inconceivable without GIS.

On the other hand, GIS have also set the limits of what can be done with spatial data. Some of these limitations are rooted in the original design of GIS as systems for 2D cartography and spatial planning. While 3D “extensions” for exploring and publishing data with “Z” values exist, they do not extend into (and sometimes interact poorly with) core GIS concepts such as topological data structures.

This calls for a critical appraisal of spatial information technology in Archaeology, with its capabilities and limitations, as represented by today’s GIS.

We invite contributions that address the following subject areas:

- Technical and epistemological limitations and current frontiers of GIS.
- Advances in the academic use of GIS in Archaeology and related disciplines.
- The challenges of mapping old data in modern software systems.
- GIS in the field and for cultural heritage management.
- Systems and data integration between GIS and related technologies.
- Novel and creative developments in software and methods for spatial data analysis.
- Open source and open data infrastructures for spatial science.

Irmela HERZOG | Lothar WELLER, Germany

Towards identifying the course of a route mentioned in 1065

Keywords: Historical maps; old roads; digital elevation models

Abstract: According to a historical document dating back to 1065 AD, the Medieval road known as Strata Colonensis connected the monastery of Essen-Werden with Cologne in Germany. Two alternative hypotheses concerning the course of this route have been published, both agree on the southern part of the course between Hilden and Cologne. In their arguments, the supporters of both hypotheses refer to historical maps. The aim of the paper is to identify the most probable course of the Medieval road between Essen-Werden and Hilden by assessing the available historical maps and other sources, and by evaluating the geographical data in this region by appropriate GIS methods. Some details concerning the approach to be presented: The earliest map known to us that shows relevant road connections in this area is attributed to Henricus Hondius. This map was probably created in 1636 and was copied several times afterwards. Fortunately, the relevant map section could

be accessed in two online archives free of charge. Georeferencing the early maps (including a map set finished in 1715) was not possible due to their distortion, instead these routes were transferred approximately to modern maps. Several Web Map Services show georeferenced map sets initially created in the 19th century. However, the accuracy of the earliest georeferenced maps is an issue. But often digitized roads on early maps coincide quite well with later routes on more accurate later maps. Moreover, typical archaeological approaches such as visualization of high resolution elevation data or aerial images could be used to identify old road sections in some areas. However, this is limited by substantial modern landscape modifications. Due to these changes, least-cost path analysis should not be based on modern geographical data in this area. But 19th century contour lines allow assessing the costs of the two routes.

Menne KOSIAN | Rowin VAN LANEN, The Netherlands

The importance of history for climate adaptation; Confronting modern spatial problems by overcoming historical-limitations of traditional GIS modelling

Keywords: historical GIS; spatiotemporal climate adaptation policies; historical data integration

Abstract: Over the last few decades the impact of climate change and corresponding weather extremes in the Netherlands increasingly has become evident. In order to better protect the country against these extremes the Dutch government has initiated an intergovernmental 'Delta' program. Through this initiative cities are obliged to develop planning policies that cope with weather extremes such as extreme rainfall or droughts. Besides traditional flooding, heat has become an increasing problem for cities in the Netherlands. Not only damaging buildings, but also risking the health of especially the sick and the elderly. In order to help cities develop (spatial) adaptation policies coping with these extremes, the 'stress-test climate adaption' was developed. Built-up out of several GIS-based models, this test depicts possible bottlenecks for flooding or inner-city heat. Despite being multidisciplinary, these models are solely based on contemporary variables and contain almost no historical data on geophysical setting or town development and morphology. Consequently, the current models ignore crucial spatiotemporal variables essential for accurate climate stress-test calculations.

In order to increase the chronological resolution of the climate adaptation stress-test models a number of municipalities, reflecting many of the old historical towns in the Netherlands, have asked the Cultural Heritage Agency of the Netherlands (RCE) for additional historical (spatial) data. This way the GIS-based models will not only be more accurate but also better equipped for incorporating town-specific heritage situations.

In this contribution we will present several examples of expanded stress-test climate adaptation models incorporating historical water systems, natural-landscape dynamics, climate change and urban morphology. The resulting models show the essentiality of integrating (1) cultural and natural data, and (2) modern and historical data. Additionally, these models underline the importance of cultural-heritage research for modern policy and planning purposes.

Relevance for the conference: this paper gives an example of using modern GIS technologies for integrating historical data into modern policy making

Relevance for the session: this paper shows how limitations of traditional GIS approached can be overcome by integrating historical water board data into modern climate adaptation policies

Innovation: A new way of georeferencing historical maps to make a integrated spatiotemporal GIS for policy makers

References:

- <https://erfgoedruimte.nl/ruimtelijke-opgaven/themadossier-stresstest>
- <https://erfgoedruimte.nl/ruimtelijke-opgaven/water>

Lucia MARSICANO | Domenica DININNO | Fabio REMONDINO, Italy

Entertainment buildings during the roman empire: where, when, why

Keywords: Archaeology, WebGIS, geo-database

Abstract: The reported project features the creation of a webGIS containing data about entertainment structures in the whole Roman empire: stadiums, circuses, theaters and amphitheaters. Starting from the study of J. H. Humphrey (1986) and R. G. Chase (2002) who collected information about these typology of buildings during the Roman period, we integrated more recent historical information, together with modern maps and satellite data. The realized geo-database of the Roman structures gives access to information such as localization, name, country, if there are any archaeological remains and if the monument is still visible.

The webGIS will be published in august 2018 on the web site of 3dom

(<http://3dom.fbk.eu/repository/eta>) with open license.

Moreover the results of the presented work are useful to (i) analyze the relationship between buildings and surrounding lands, (ii) perform advanced hypothesis about the accessibility to the structures or the role of these typology of buildings in the urbanistic context, (iii) understand relationship between entertainment and society and (iv) identify concentrations of structures in certain regions.

This research is mostly focused on the circuses, the study of satellite images, published and historical sources allowed to recognize seventysix circuses all over the roman empire. Forty four of these circuses are located and twenty-eight are still visible today.

This data shows the distribution of the circuses in the roman territories and it is interesting to notice that in Italy these structures are rare (except in Rome) but are widespread in Spain (20% of the circuses are in Spain).

Other interesting information concerns the era of construction.

For only forty two circuses the century of construction is known, among these eighteen were builded during the I century CE and seven during the IV century CE.

The buildings constructed during the I century are mostly public, the ones from the IV century are all palatial circuses, that means they are linked to imperial residences.

These are only an example of the possible researches, further studies are in progress.

Relevance for the conference: To demonstrate the potential of a webGIS platform for sharing the collected information about Roman entertainment structures.

Relevance for the session: To create an awareness of the open platform to collect more historical information and allow studies and analyses.

Innovation: The realized web platform, composed of a geo-databases enriched with historical information about Roman structures, could be a useful tool to study and collect data about a complex and weakly studied topics: the geographic distribution of entertainment structures and their relationship with territories.

References:

- J.M. Costa - García, The potential of the Geographic Information Techniques for the analysis of the morphology and settlement patterns of the Roman military sites of early imperial era in Iberia, in V. Mayoral Herrera, C. Parceró – Oubina, P. Fabrega-Alvarez Archaeology and Geomatics, Sidestone Press, 2018
- R. G. Chase, Ancient Hellenistic and Roman amphitheatres, stadiums, and theatres: the way they look now. P. E. Randall, Portsmouth 2002

Reza SHARIFI | Somaye FAZELI | Alireza IBRAHIMI, Afghanistan

Spatial Data Infrastructure for Urban Heritage Conservation in Afghanistan, the case study of Herat in Afghanistan

Keywords: Urban Heritage Conservation, SDI, the Old City of Herat

Abstract: The development of Spatial Data Infrastructure (SDI) in the field of urban conservation in Afghanistan is a new topic and less explored. This article studies the framework of the SDI to provide a platform for sharing, assessing and discovering the data by users, spatial data providers in different sectors of public and private. This paper not only contextualises this tools and methods in the old city of Herat, a city in western Afghanistan that contains some of prominent Timurid architect but also develops the core part of preparation phase and data management in the research project of “Regeneration and Preservation of the Historic Urban Fabric of Herat”. After archiving and managing various forms of spatial and non-spatial data related to the Site, which have been produced by different institutions since 2001, the research develops an SDI with combining the satellite images, spatial datasets and attribute data (e.g. social survey, household survey). It continues with designing several conceptual models and also a Geoportal to visualise, modify and discover historic urban fabric of Herat. To reach this aim, we utilise the standards of ISO and OGC. The product of this study enables the different key institutions in the field of heritage conservation to access the portal to obtain, modify and contributing to the data collection. Taking the strength and limitation of SDI in to consideration especially in Afghanistan, this research aims to facilitate the researchers, urban planners and managers in proper decision-making to protect the cultural heritage.

Relevance for the conference: The article develops the new technologies related to the GIS to the field of urban heritage conservation.

Relevance for the session: We are developing a platform with using GIS and SDI for gathering, sharing and managing the data, aiming at the preservation of cultural heritage in Afghanistan.

Innovation: Using these tools and methods are new in Afghanistan, a county in post-armed-conflict.

References:

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Bence VÁGVÖLGYI | Gábor SERLEGI, Hungary

Mapping earth forts from every angle: results of the combination of multiple non-destructive survey methods in a GIS framework

Keywords: non-destructive survey ; GIS ; 3D analysis

Abstract: Throughout many different eras, from the neolithic to the medieval period, earth forts constitute vital focal points of the historic landscape. As such, they are an integral part of any area's cultural heritage. Their location, their various shapes, sizes and structure can also tell us a lot about the peoples that built them. However, they are under continuous threat from erosion and growing agricultural production, especially in flat, lowland areas like the eastern part of Pest county in Hungary. Therefore while the main goal of our research was to map these forts for a spatial database, it also became imperative to survey the endangered ones in detail.

Thanks to the ever-growing amount of aerial- and satellite photography available, more and more of these sites can be identified with greater accuracy. To be able to explore them in detail, however, we need to employ a number of local scale non-destructive survey techniques. These methods (ranging from geophysics to artefact collection) make it possible to map different characteristics of past structures. However, each of them only describe one aspect of the site. Only by using them in combination with each other (connected through GIS) can we draw a complete picture of these complex structures.

The presentation aims to show how the consistent use of a GIS framework enhanced our survey efforts from planning, through fieldwork execution, to the processing of the data. We also aim to show how through this combined analysis, the results of the different survey methods can complement each other to form a more detailed picture of the earth forts of Pest county.

Relevance for the conference: The presentation shows how modern fieldwork technology and digital spatial processing can help map sites in much more detail, thus allowing them to be better protected.

Relevance for the session: The presentation explains how GIS can be used as a tool for combining different survey datasets, thereby enhancing the results that can be obtained from them.

Innovation: The use of these methods through a common GIS framework allows for a more accurate planning of fieldwork as well as opening new ways to look at the obtained data.

Rowin VAN LANEN, The Netherlands

Mapping monumental churches. The challenge of applying GIS on the religious landscape of the Netherlands

Keywords: Historical religious landscapes, Monumental churches, Heritage management, Collaboration, Geographical Information Systems (GIS)

Abstract: Similar to other regions in Europe, Dutch (historical-)town centres often are dominated by monumental religious buildings. Due to their spatial and cultural importance many of these buildings have been designated as national-heritage sites during the course of the twentieth century. At present, 2351 (mainly historical) churches are protected (but not owned!) by the state. Mainly due to declining

attendance an increasing number of these buildings, are now in danger of becoming vacant. Not only directly threatening the conservation of these historical monuments, but also further complicating future spatial-planning challenges.

Since upcoming legislation will oblige smaller governments to specifically include churches (both monumental and non-monumental) in their (long-term) environmental planning, an integrated overview of the Dutch religious landscape is much needed! Against this background the Cultural Heritage Agency of the Netherlands (RCE) issued a nation-wide mapping programme of these state-protected churches. The main aim of this exercise was to (1) improve the quality of, and enhance the data in, our own monumental register, (2) create a nationwide GIS containing these and showing the potential of these large-scale spatial analyses for the challenges mentioned above, and (3) take a first step towards an integrated (spatial) overview of the complete Dutch religious landscape. Creating such an overview is challenging because of strong regional differences and varying denominations and ownerships.

In this contribution I will focus less on technological restraints but more on the social limitations of applying GIS in a field relatively new to data-management and GIS. I will argue that applied GIS methods and theories are limited by, and need fine-tuning with, the digital knowledge of heritage experts. In this contribution I will illustrate how the complex interaction between data (e.g. quality, availability), expert knowledge, political and economic agenda's and multiscale collaboration can fundamentally influence GIS application in heritage management.

Relevance for the conference: Paper focuses on applying GIS in the field of heritage and finding best practices for dealing with complex project situations.

Relevance for the session: Further adding a variable to the discussion on the application of GIS in the field of heritage.

Innovation: Identifying the social complexity of applying GIS in built-heritage research and the differences of applying spatial research in the different heritage fields.

Heritage-BIM between Survey, Planning and Management

Chairs: Claudiu SILVESTRU, Austria | PIOTR KUROCZNSKI, Germany

BIM (Building Information Modelling) is considered by most of the AEC industry (Architecture Engineering Construction) the tool of the future for planning, building and managing constructions. The main concept behind BIM is to make pluridisciplinary work more efficient by storing, sharing, changing and disseminating data over the lifecycle of a building based on a common parametric 3D model. In the case of new building projects this saves time, costs and facilitates coordinated working in complex team structures with different professionals.

For several years now BIM gains importance also for the heritage sector, due to advantages in the documentation, refurbishment and management of historical buildings such as:

- survey and research results in different formats and from different professionals can be joined in one model providing a solid base for both further research as well as refurbishments and interventions;
- the BIM-model provides centralized and - if maintained constantly - up to date information on the preservation state of the asset facilitating a better planning of necessary conservation interventions both in terms of timing and costs.

Research as well as case studies have pointed out also several disadvantages of “Heritage-BIM” especially when adopting the approach directly from new building projects, among which:

- the geometry of historical buildings is generally far more complex leading to modelling problems as well as data storage issues;
- each building and its element are unique, reducing the efficiency of BIM through re-use of its parametric elements.

This session’s aim is to discuss the challenges and potentials of BIM in building survey, refurbishment projects and the management of heritage sites.

Andrea ADAMI | Nazarena BRUNO | Olga ROSIGNOLI | Barbara SCALA, Italy)

HBIM for planned conservation: a new approach to information management

Keywords: HBIM, semantic classification, information modelling

Abstract: HBIM represents a very promising tool for the management of Cultural Heritage, both for daily operations and for the planned preservation of the asset itself. However, they require a specific effort to adapt tried and tested tools and methods for new construction to existing Cultural Heritage buildings. First of all, it changes the starting point of the process (new construction projects, surveys for existing buildings) and consequently the requirements for geometric and informative modelling change.

Especially in the field of Cultural Heritage, an in-depth and reasoned design of such a model (geometric and informative) is necessary to respond well to the needs identified in the processes of planned conservation. To this end, an appropriate semantic classification of the building elements must be carried out prior to modelling, taking into account both documentation and geometric description requirements.

The aim here is to propose a system for managing the information component of the model that takes its cue from the internal logic of BIM Authoring (Autodesk Revit) software and takes into account the operating practices of operators in the conservation sector. In particular, a system is proposed which no longer takes into account the traditional two-dimensional classification of elements, but which directly affects three-dimensional technological elements.

This is the case of the remains of the convent of S. Maria, near Lake Garda, where the geometric modeling was structured according to this new model of management of information content. In this way it was possible to give a complete description of the reality of the building (and its surroundings) without making it more usable and more readable by the operators.

Relevance for the conference: HBIM approach seems to be very promising for the management of CH

Relevance for the session: In a HBIM approach, we need to think to new systems of semantic classification to be applied to CH

Innovation: The new classification system takes into account the needs of the planned conservation together with the characteristics of the software itself

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Damien CAMPBELL-BELL | TBC, UK

BIM and Commercial Archaeology: A Critical Perspective

Keywords: BIM, Commercial Archaeology, Project Management

Abstract: Within the AEC industry the focus is on BIM as a project management tool, underpinned by an information rich 3D model. This tends not to be how most heritage professionals engage with BIM, however, and even AEC professionals fail to fully explore the benefits BIM can bring to heritage projects (Atkinson et. al, in press). There is, on both sides, a failure to understand the needs and benefits of a holistic approach.

Instead we should look beyond BIM as an information repository for historic buildings, as is common in heritage circles, and not treat historic buildings in the same way as a new build, as is common in the AEC industry. The application of BIM as a project and asset management tool could increase efficiency, decrease problems and lead to better outcomes for both clients and heritage assets. This applies not just to historic buildings, but to construction and infrastructure projects too. Such use of BIM could create significant changes in the way commercial archaeology companies operate and interact with stakeholders.

This presentation will first review how BIM for Heritage has previously been conceived and implemented. It will then use a number of examples to outline how, with a holistic view of its use, it can be used to benefit many types of archaeological project, including pre-construction survey and mitigation works.

Relevance for the conference: This presentation will look at the best way to apply BIM, a relatively new technology/process, to a broad spectrum of cultural heritage projects, including the mitigation of archaeological risk ahead of construction

Relevance for the session: This presentation will offer insight into how the utility of BIM can be maximised in heritage, expanding beyond the approaches often seen in presentations and articles on the subject

Innovation: This presentation will give an holistic view of BIM's use in heritage rarely seen in the heritage or AEC industries

References:

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Lorenzo CECCON, Italy

A New Perspective on Heritage and Multi-dimensional Representation with H-BIM

Keywords: Overlapping Geometries in BIM, Multi-dimensional Representation for Cultural Heritage, Layered 3D Reconstruction in HBIM

Abstract: BIM can be seen as a multi-dimensional modelling technique for AEC, where a database of different data sets is linked to geometries, containing valuable information about physical and rendering features, among others. The main BIM packages also allow for multiple geometries to be stored for each architectural element, as it is the case with the Level of Detail (LOD), storing different shapes for the same elements based on the chosen level. However, current software packages seem not to be addressing one of the main issues related to heritage buildings: the overlapping of a series of geometries relating to different aspects of reality. This is true for various forms of decay – e.g. see the ICOMOS-ISCS – where, for instance, the shape an incrustation assumes is often not “aligned” or “limited” to the geometrical features of one unique, nor entire, architectural element. Similarly, this applies to structural sub-elements, such as stones in a stone-wall: in fact, depending on the goals at stake, a whole element or only its constituents can become relevant for the representation and the analysis. For instance, a structural analysis may be better accomplished starting from the constituting stones and their separation, while a rendering might well start from the wall as an unique element. This requires the co-existence of the overall shapes and of its constituents within the same model, so that the latter add up to a perfectly overlapping unity, exactly matching the former. The paper investigates the state of the art of H-BIM vis-à-vis such non-univocal geometrical features and tries to envisage possible new uses of current tools. It also tries to devise new features that could be easily added to current modelling/BIM packages, in view of providing BIM tools that can better represent and describe heritage buildings, thus also helping in their preservation.

Relevance for the conference: Exploring current limitation and some proposal for further development in H-BIM

Relevance for the session: Recognizing some neglected issues in H-BIM such as overlapping geometries, and proposed solutions.

Innovation: Rethinking current H-BIM and modelling tools starting from major neglected aspects, such as overlapping geometries in multidimensional models.

References:

- Laila M.Khodeir et Al. "Integrating HBIM (Heritage Building Information Modeling) Tools in the Application of Sustainable Retrofitting of Heritage Buildings in Egypt", 2016, <https://doi.org/10.1016/j.proenv.2016.04.024>, <https://tinyurl.com/y7byhugy>

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Gabriele FARRE | Emilia VALLETTA | Zarif EZDEŞİR, Italy

Heritage-BIM between Survey, Planning and Management Making the walls telling their story: a low cost interactive proposal for the Castle of Girne, North Cyprus.

Keywords: BIM, point cloud, 3D laser scanner, masonry, restoration, data collection

Abstract: Built Information Modeling (BIM) is quickly becoming a standard in managing and documenting the built world for development and maintenance, but when applied, this solution may be consuming and expensive. The procedure proposed can be considered as an entry level alternative to BIM technology in situation with critical budget and in need to move later towards a more complete BIM solution. In the next future the BIM approach (based on the interoperability of data) will be more present and integrated, becoming a new paradigm in design interventions, maintenance plans as well as being easily accessible via VIM (Virtual Information Modeling) tools. The case study presented focuses on the investigation of the geometric aspects and informative surveys (via 3D laser scanning and photographic acquisition) of the walls of Kyrenia-Girne Castle in North Cyprus. Evolving from the two surveys, a simple procedure was created to allow the insertion of additional punctual information from different means to complement and enrich the geometric modeling, such as type of constructive technique and materials of the walls, colors, static functions, state of conservation and photographs, to get to the final aim of the research which is the walls dating. With this premise it is possible to propose solutions that, starting from digital survey data, can provide rapid and effective information, ensuring results that can be cross-referenced. The use of Autodesk Recap provided the possibility to link photographic images, external links like references, data, PDF files, to specific points within the point cloud. The resulting version of the point cloud is compliant with the use of Autocad, 3D Studio Max and especially in integration with Autodesk Revit; it may influence positively the construction of a full BIM model, exploiting data gathered and linked to the point cloud for the creation of the general models and its families.

Relevance for the conference: A low cost approach to documenting and sharing data from digital survey for research and restoration purposes

Relevance for the session: An alternative approach to organizing data with operators of various skills and abilities

Innovation: Use of available tools and definition of procedures in a yet not well explored and exploited software, with the intent to share it with architects, archaeologists, cultural heritage experts

References:

- Enlart, C. (1899). L'art Gothique et la Renaissance en Chypre. Paris: Ernest Leroux Éditeur;
- Camiz, A., Khalil, S.I., Demir, S.C. and Nafa, H. (2016). The Venetian defense of the Mediterranean: the Kyrenia Castle, Cyprus (1540-1544). In: G. Verdiani (ed.). FORTMED 2016. Defensive architecture of the Mediterranean. XV to XVIII Centuries. vol. 3. Firenze: DIDApres, pp. 371-378.

Piotr KUROCZYŃSKI | Julia BRANDT | Karolina JARA, Germany

New Synagogue as HBIM – Merging historical information with BIM-conform models

Keywords: Heritage/Historic BIM, sourced-based 3D reconstruction, data modeling, visualization

Abstract: The project of the sourced-based 3D reconstruction of the 1938 destroyed New Synagogue in Breslau, now-a-days in Wrocław (Poland), is concerned with the scientific documentation of the dispersed knowledge and the process of the computer-based reconstruction in general. The 3D model is traded as a scientific information model with a traceable and valid content, stored in a sustainable and interoperable format.

The main issue is to use Building Information Modeling for the visualization of the cultural heritage and the storage of the humanistic knowledge from object-oriented disciplines like art and architecture history as well as archeology. The project examines the scientific methodology of 3D reconstruction according the BIM-standard and IFC data model from current construction industry in conjunction with the documentation standard from the cultural heritage sector.

The core documentation system is based on customized Virtual Research Environment (Drupal 8) with CIDOC CRM referenced application ontology and graph database (RDF-Triple-Store) in the backend. One of the research question is dedicated to the integration of the humanistic research issues within the BIM-conform 3D model and it's IFC-based attributes. Furthermore the process-oriented capture of the scientific 3D reconstruction within the Virtual Research Environment, namely the linkage between the sources, the creative decisions and the hypothetical 3D results, will be discussed. In the end the the visualization aspects of the historical information in web-based viewer, like Solibri Model Checker and Tekla BIMsight, will be presented.

The overall aim of the project is to explore the advantages, challenges and thresholds in using the BIM-standard for historical object-oriented research, reviewing the benefits of structured Linked Data and web-based visualization.

Relevance for the conference: The paper examines the emerging field of BIM-conform modeling and visualization in the field of archeology, art and architecture history.

Relevance for the session: The paper has an authentic impact for the HBIM session.

Innovation: The linkage between BIM/IFC and CIDOC CRM and the visualization of the historical information is innovative and promising.

References:

- Kuroczyński, P., 2017. Virtual Research Environment for digital 3D reconstructions – Standards, thresholds and prospects. *Studies in Digital Heritage* 1, 456.
<https://doi.org/10.14434/sdh.v1i2.23330>
- Antonopoulou, S., Bryan, P., 2017. BIM for Heritage - Developing a Historic Building Information Model. *Historic England*.

David ZELL | Amir FREUNDLICH | Iosi BORDOWICZ, Israel

Photogrammetric Modelling and digital Reconstruction of the ancient synagogue in the National Park of Baram

Keywords: Synagogue, Reconstruction, Photogrammetry

Abstract: This paper presents the use of multi photogrammetric models, as a BIM parametric model for the digital reconstruction of the ancient synagogue in the National Park of Baram, in the north of Israel.

The synagogue was built at the end of the fourth century A.D, above the remains of an earlier building. It's one of the best preserved ancient synagogue in the north of Israel, and has high archeological, architectural, and cultural value. The synagogue was partly reconstructed in the late 50s of the 20th century, with the reuse of original architectural elements and by casting concrete replicas.

The project's goal was to provide accurate 3D photogrammetric modelling and digital reconstruction of the building, for planning future intervention in the site.

This project was initiated by the Israel Nature and Parks Authority in 2017 and was realized through the cooperation of a professional team of Conservators, Architects, Engineers and Archaeologists.

To achieve comprehensive and accurate recording, a photogrammetric scan of the building and of 50 architectural elements found on site was prepared in a Cad environment, using Agisoft Photoscan, Rhinoceros and AutoCAD software, alongside an engineering and architectural surveys.

First, the 3D model was used to create a set of drawings of the synagogue present condition, and a 3D Inventory of the architectural elements.

Secondly, a 3D reconstruction and visualization of the synagogue was created, based on the 3D models and historic data gathered while documenting the site (figure 1).

This project is a base for future research and planning, that is still ongoing today.

From our experience in the Baram project, the combination of multiple photogrammetric scans as a base for 3D digital modelling, reconstruction, and visualization in a Cad environment, has significant advantages in quality and efficiency in the conservation process.

Relevance for the conference: The project is relevant to the conference title "VISUAL HERITAGE 2018" by presenting an Innovative implementation of the use of 3D technology to modeling, reconstruction and visualization of the synagogue in Baram.

Relevance for the session: The 3D photogrammetric scan of the synagogue in Baram was the base for all the work of surveying, digital reconstruction, and planning, that was done directly on the 3D model by the professional team. It demonstrates the potentials of using a photogrammetric 3D model as BIM.

Innovation: The process of scanning multiple photogrammetric models as the base for the conservation process, creating a 3D Inventory of the architectural elements, and creating a 3D reconstruction and visualization based on the 3D models is new to us and was developed specially for the Baram project

References:

- Aviam M., The ancient synagogues at Bar'am. *Judaism in Late Antiquity* III,4 (2001) 155-177.
- Kohl, H., & Watzinger, C. (1916). *Antike Synagogen in Galilaea*. Leipzig: der Deutschen Orient-Gesellschaft

Images of the past – challenges of computer generated image-based representation of cultural heritage

Chairs: Krzysztof KOSZEWSKI, Poland | Fabrizio Ivan APOLLONIO, Italy | Piotr KUROCZYŃSKI, Germany

Computer image-based representation and visual computing are rapidly growing in the Cultural Heritage field. Different kinds of visualisations (2D, 3D, still or time-based) act as knowledge encoding and transfer tools in many applications, ranging from research to dissemination of results. All these issues are influenced by the pictorial character of contemporary culture, causing demand for a high level of realism in order to be accepted by wider audience.

Despite this widespread use of Computer Generated Images, there are no common rules and standards for visual language used in cultural heritage representation. The ability to represent the confidence level of geometric 3D modeling in hypothetical reconstructions, different type or level of uncertainty, chronology, as well as ensuring their transparency related to evidence data, archival documents, and conjectural interpretations – these are crucial features of imaging the Past. It's hard, if not impossible, to achieve these aims without established canon of representation.

If computer-based visualizations are considered to be, according to London Charter, intellectually and technically rigorous tools, then there is a critical need for such consensus on visual language used in the process of creation of CH representations. On the other hand, there are long traditions of graphic standards for visualisation of chronological stratification, also established rules for architectural photography, as well as case studies of already applied solutions, which may be used as starting point for discussion.

The purpose of this session is to pursue efforts of analyzing possible solutions in order to raise effectiveness of knowledge transfer using visual means in the field of cultural heritage. Critical state-of-the-art analyses, solutions proposals, case studies referring to the session subject are welcome.

Robert Peter BARRATT, UK

Defining a 3D methodology in archaeology: the issue with alternative models.

Keywords: alternative models, 3d reconstruction, visualisation, metadata and paradata

Abstract: 3D reconstruction is widely used today in archaeology, yet its methodology has not entirely been accepted within traditional practices.

Partially due to a lack of standards and theoretical support, partially due to a mistrust for new technology, key issues in the handling of 3D data are yet to be resolved. This is especially true with the management of inaccuracy within 3D models. The use of metadata and paradata have minimised concerns, but there is yet to be clarity on the preferred method of displaying uncertainty.

One solution proposed has been the creation of alternative models, displaying conflicting theories within the 3D reconstructions.

Here we discuss the advantages and flaws of this technique, ultimately demonstrating its limitations and proposing a more theoretical approach to the issue.

Creating alternative models of conflicting hypotheses can be of great use in specific cases, especially when the interpretation of an archaeological site is unsure. But it is not a general solution to the problem of uncertainty. Limited publishing space and a need to propose a clear narrative to the public seriously hinder the use of alternative models. Additionally, technical limitations in the modelling process can lead to prolonged reconstruction times. As a response we propose the establishment of solid guidelines and the investigation of the theoretical background of 3D reconstruction to align this methodology with traditional practices.

Demonstrating the similarities between new and old practices will minimise issues of uncertainty and help establish the validity of 3D reconstruction.

This paper is part of a process of assessment and analysis of the 3D method, in an attempt to create a solid philosophical background that can withstand current criticism and ultimately result in a wider use of high quality 3D reconstructions in archaeology.

Relevance for the conference: The paper is on issues at the core of Visualisation and Virtual Heritage.

Relevance for the session: The paper deals with the theoretical background of 3D reconstruction, focusing on the best way to display inaccuracies in 3D data.

Innovation: The paper analyses a much discussed technique with the intention of demonstrating its limitations and proposing an alternative.

References:

- The topic has not been discussed in these terms, but many authors have touched upon the subject. Examples include Mathur 1997; The Guardian 1999; Huggett and Guo-Yuan 2000; Lock 2003; Alusik et al. 2011

Christiane CLADOS, Germany

Cultural Heritage and 3D Characters

Keywords: 3D character, cultural heritage, simulation, archaeology, ethnography

Abstract: Hypothetical reconstructions of 3D characters is a segment of the Cultural Heritage field that is seeing strong growth during the last years. As they give a good idea of what ancient people looked like they contribute towards a better understanding of a particular aspect of cultural heritage. Also in the visualization of ancient people in the pre-Columbian Americas 3D technology plays a critical role as a tool to “translate” scientific data to make them accessible to the general public. The conception of such visualizations has various influences and the models are supplied with data from different sources, e.g. archaeology, iconography, ethnohistory and ethnography. On the basis of one simulation the present project aims to show how scientific data of different disciplines are transferred into this type of visualization. The simulation focus on dress and ornaments worn by chiefs in the cultural area of Calima at around AD 600, which more or less coincides with the modern-day upper and middle region of the Calima River in Colombia. The central question is how all this summarized information can be visualized in a 3D model. Another focus of the presentation is on the question whether CH representations can be anchored in a theoretical framework.

Laura FARRONI | Matteo Flavio MANCINI | Silvia RINALDUZZI, Italy

Deferred executions: digital transcriptions of unbuilt architectural projects

Keywords: digital transcriptions, 3D digital models, unbuilt architectural

Abstract: The present paper proposes some considerations on methods aimed to the construction and visualization of 3D digital models based on design drawings of unbuilt architectures. In this case, some of the Francesco Cellini's projects, provided by the author and now retained at the Projects Archive of the IUAV University of Venice, were analyzed. The methods of digital construction have been aimed at highlighting and disseminating the architect's poetics, design strategies and spatial configurations. The tested procedures considered the most suitable visual language to communicate the different degrees of verisimilitude (from the symbolic to the iconic) in the process, allowing to manage the quantity and quality of information throughout the whole process, from data acquisition to final visualization. Various variables were considered, such as: the type of recipients, the quantity and quality of the starting data and the possible interpretations of the available sources according to the theoretical assumptions considered. Such assumptions refer to the architectural restoration theories and allow to consider the visual design as a deferred project of the original one.

The final product is a geometric and information model in which both the steps of interpretation and the final result can be identified. The steps description of the reconstruction process allows the verification and critical systematization of the sources while the final result intends to communicate the interpretation of the architect's work and poetics. In order to describe the type of model realized and aiming at the establishment of a shared methodology in the field of virtual reconstructions of unbuilt architectures we propose, in analogy with the concept of Italian LOD applied to BIM, the experimentation of a Level Of Reconstruction value (LOR) that is a function of both the level of detail and metric/geometrical accuracy and the level of reliability of the reconstruction itself.

Relevance for the conference: Theory, tools and methods for the study and digital enhancement of cultural heritage retained in architectural archives

Relevance for the session: A focus on the existing relationships between visual language and the knowledge entrusted in the design drawings of unbuilt architectural projects

Innovation: Experimentation of a Level Of Reconstruction (LOR) value aimed to establish a scientific approach to the architectural reconstruction process

References:

- T. Maldonado, "Reale e Virtuale". Milano: Feltrinelli, pp. 15-154, 2007
- M. Manieri Elia, "La conservazione: opera differita", in Casabella, 582. Milano: Mondadori, 1991, pp.43-45.

Marc GRELLERT | Fabrizio Ivan APOLLONIO | Bob MARTENS | Nobert NUßBAUM | Mieke PFARR-HARFST, Germany

Working Experiences with the Reconstruction Argumentation Method (RAM) Scientific Documentation for Virtual Reconstructions – www.sciedoc.org

Keywords: Virtual Reconstruction, Documentation, Standards, Online Tool, Scientific

Abstract: Based on the absence of standards for scientific documentation of virtual reconstructions and the lack of such documentations themselves, the goal was to develop a clearly user friendly and

easy understandable online tool which can be used without any prior knowledge or specific software know-how.

In the course of the recording of the reconstruction process, the outcome (model) is divided into several different areas. For each of these areas one or more alternative solution can be documented in order to explain how the model has been setup.

Every final outcome (or variant) of the reconstructive hypotheses is represented by the set of images of the reconstruction and the relative documentary sources. Both are linked up by the verbal argumentation.

The paper will present the elaboration of the project and the discussions of the involved partners concerning some of principal question related to imaging the past:

- What should be the intellectual, the technical and the aesthetic approach to ensure the transparency of hypothetical reconstructions process?
- What would be the appropriate way of representing (a) the level of confidence of geometric 3D modeling in hypothetical reconstructions, (b) different type or level of uncertainty and (c) chronology?
- What would be the best way to ensure the transparency related to evidence data, archival documents, and conjectural interpretations?
- What ought to be a reasonable categorization of plausibility of reconstructions?
- What would be the best way to use the interface as a communication tool during the reconstruction process which will be at the end already the documentation?

The ongoing development and implementation of the web-based platform could be starting point for discussion on possible solutions in order to raise effectiveness of knowledge transfer using visual means in the field of virtual reconstruction.

Relevance for the conference: Discussions of scientific documentations and standards are needed in the field of digital heritage.

Relevance for the session: There is still a lack of scientific documentations of virtual reconstructions and their standards has to be discussed.

Innovation: The proposed minimal standard for documentation is still new in the field of virtual reconstructions and is one answer to a needed scientific documentation.

References:

- Pfarr-Harfst, Mieke / Grellert, Marc: The Reconstruction – Argumentation Method: Proposal for a Minimum Standards of Documentation in the Context of Virtual Reconstructions, in: Ioanides, Marinos / u.a. (Hg.), Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection, Heidelberg, Berlin 2016, S. 39-50
- Pfarr, M.: Dokumentationssystem für digitale Rekonstruktionen am Beispiel der Grabanlage Zhaoling, Provinz Shaanxi, China. TUprints, Darmstadt (2010). <http://tuprints.ulb.tu-darmstadt.de/2302/>

Dominik LENGYEL | Catherine TOULOUSE, Germany

Interactive Virtual Reality for a grasping understanding of an architectonic concept

Keywords: visualisation uncertainty knowledge hypotheses design

Abstract: During the Counterreformation, in the early seventeenth century, the archbishop of Würzburg, Julius Echter von Mespelbrunn, built several hundred village churches, that follow a common principle, that by itself has never been realized due to the varying preconditions. Prof. Dr. Barbara Schock-Werner, the former master builder of Cologne Cathedral, verbally described this hypothetical ideal church in her habilitation treatise.

The project demonstrated in this paper describes not only how the ideal church has been translated from the verbal into a virtually modeled state, but also its mediation to the public by an interactive Virtual Reality experience introduced by a narrative film and a physical model.

In the first phase of the interaction the operator composes Echter churches from a given set of building parts by identifying, selecting, arranging and orienting these parts with special controllers that represent his hands. The objects are represented in the common model scale 1:100 and seem to behave physically correct. This way, handling and behavior encourage the operator to experiment. When the operator successfully composes a church's volumes, he is forwarded to an original scale model that allows to walk around the churches, the ideal church also from the inside.

It is one of the specific strengths of Virtual Reality not only to simulate space and interact with it, but to deliberately switch between different states, e. g. scales, levels of details or, most important, abstraction – just as in images or texts. Particularly abstraction, if carefully designed, allows to demonstrate, explain, illustrate and understand concepts that otherwise can only be perceived subtly. The project has been realized for the exhibition „Julius Echter. Patron der Künste. Konturen eines Fürsten und Bischofs der Renaissance“, exhibited in the University of Würzburg's Martin von Wagner Museum in the Würzburg Residence from June 25 to September 24, 2017.

Relevance for the conference: The paper shows how abstraction in interactive VR is the next step in mediating hypotheses in cultural heritage.

Relevance for the session: VR demands a different canon of representations even if in consequence of image based representation.

Innovation: The demonstrated VR experiences unveils there potential to enhance spatial simulation by in multi-dimensional explorations through differents states.

References:

- Lengyel, Dominik; Toulouse, Catherine (Hg.) (2015): Die Bedeutung architektonischer Gestaltung in der visuellen Vermittlung wissenschaftlicher Unschärfe. In: Jahrestagung Digital Humanities im deutschsprachigen Raum DHd, Karl-Franzens-Universität Graz 2015. (Url: <http://gams.uni-graz.at/o:dhd2015.v.033>)
- Lengyel, Dominik; Toulouse, Catherine (2013). Die Bauphasen des Kölner Domes und seiner Vorgängerbauten: Gestaltung zwischen Architektur und Diagrammatik, in: Dietrich Boschung, Julian Jachman (Hg.), Diagrammatik der Architektur, Tagungsband Internationales Kolleg Morphomata der Universität zu Köln. Verlag Wilhelm Fink, Paderborn. ISBN 978-3-7705-5520-8

Małgorzata MARKIEWICZ | Aneta BUCHNER, Poland

3D images as a source for analysis and interpretation of data obtained during archaeological research

Keywords: image, visualization, archaeology

Abstract: The will to protect cultural heritage has become an impulse to construct three-dimensional visualizations, which can be regarded as a form of discovering, studying and experiencing the past. Thanks to a computer program and properly manipulated 3D models, scientists can test out their research hypotheses, basing on mutual relations between the models. 3D modeling is a priceless tool when it comes to reconstructing archaeological structures and artefacts as well as analysing and interpreting the past. It allows to create spatial objects that can be processed in various ways. 3D visualization is a new narration form in archaeology and complements descriptions. In our society, in whose cognitive process an image begins to play a dominant role, popularization of the past with the use of digital reconstruction is particularly important. It is the visuality that determines the way we experience and analyse historical knowledge. An image in the form of a reconstruction is complete, comprehensively narrated, which means there is no room for a deeper interpretation. It is the scholar who defines the vision of a reconstructed structure. That is why an author must keep a critical distance towards their analysis when creating a visual message that provides information on cultural heritage. In order to cover the requirement of reliability when constructing a model, it is advised to follow the standards included in the London Charter.

The significance of 3D visualization as a method of presenting research hypotheses will be discussed basing on the examples of digital reconstructions of two settlements from the Early Iron Age, discovered in Lower Silesia in South-West Poland. Archaeological excavations at those sites were conducted in 2000 by the Institute of Archaeology and Ethnology of the Polish Academy of Sciences in Wrocław.

Relevance for the conference: Constructing three-dimensional images of the past by archaeologists significantly contributes to cultural heritage protection and aims to provide the society with knowledge about the past.

Relevance for the session: Visualization tools are used in archaeology, so a discussion on the advantages and disadvantages of three-dimensional reconstructions in cultural heritage protection should be started.

Innovation: Testing research hypotheses with the use of 3D models supports the interpretation of the results of archaeological research.

References:

- Koszewski K. 2016. Publikacja cyfrowa jako metoda edukacji i ochrony dziedzictwa, (in:) J. Stryk, S. Wrona (ed.), Informacyjne środowisko rekonstrukcji. Przedlokacyjna struktura osadnicza w Pułtusku w XIII-XIV wieku, Warszawa, 95-106.
- Minta-Tworzowska D. 2011. Badania nad kulturą wizualną i ich wpływ na konstruowanie obrazów przeszłości przez archeologów, (in:) R. Zapłata (ed.), Digitalizacja dziedzictwa kulturowego. Wybrane zagadnienia, Lublin, 215-334.

Dimitrij MLEKUŽ, Slovenia

Power of Images: Archaeological Visualizations in the Knowledge Production

Keywords: knowledge, visualization, representations, archaeology, heritage

Abstract: We address the role of archaeological visualizations in knowledge production using the actor-network theory. Visualizations are complex inscriptions designed to stabilize and consolidate knowledge. Visualizations can shed light on open questions, help us develop arguments and offer new interpretations. Visualizations thus become actants in the process of knowledge production and can be mobilized to significantly support interpretations. The assemblage that produces a visualization (including people, tools, machines), the visualization itself, the number of inscriptions mobilized into a visualization, parallels, generalizations, discussions, the line of reasoning etc. are in a constant process of interaction and mutually constitute each other, aligning themselves along the general arguments and ideas of the visualization, making new alignments and changing the direction of interpretation. Through this process, new knowledge and insights is gained. Visualization is therefore not the product or reflection of knowledge, but is made during the process and becomes fixed and stable through this process.. When completed, visualization looks like a coherent, solid entity, a black box. If opened, visualization reveals itself as a heterogeneous network of different actants. The line dividing “data ” and “interpretation”, “familiar” and “new”, “fact” and “hypothesis” becomes blurred and irrelevant. Visualizations are carriers of complex knowledge, communicating this knowledge using the visual language. This makes them very suitable tools for communicating complex knowledge to the wider public. Visualizations can thus be conceptualized as “boundary objects”, carriers of different meanings in different social contexts, but simultaneously maintaining a sufficiently coherent structure to be recognizable across different communities. But therein lies the danger: the visual sophistication of the visualization can be a mere facade of empty or misleading content. These “hyperreal” images do not communicate ideas, but serve only to make the past more inspiring, beautiful or interesting than it really was, in short, they are pure ideology.

Relevance for the conference: Paper brings strong theoretical approach to the visualisation of heritage.

Relevance for the session: Paper brings theoretically informed critique of image-based representation of archaeological heritage.

Innovation: Paper approaches visualisations using actor-network theory and science and technology studies and discusses their role in the knowledge production.

References:

- Burri, R.V. and Dumit, J. 2007. The social studies of scientific imaging and visualization. In J. Hackett (ed.), *The handbook of science and technology studies*. Cambridge.
- Latour, B. 1986. Visualization and cognition. Drawing things together. In H. Kuklick (ed.), *Knowledge and Society studies in the sociology of Culture, past and present*. Greenwich.

Jiri UNGER, Czech Republic

The Good, the Bad and the Ugly – What is the Confidence Level of 3D Virtual Reconstructions in Archaeology?

Keywords: 3D modelling; virtual reconstruction; imagination of the past

Abstract: The lecture will focus on different projects of 3D computer reconstruction of the sites from prehistory to medieval period realised directly by author. 3D reconstruction models of paleolithic cave settlement, neolithic dwellings, La Tène oppidum, early medieval stronghold and medieval town from Czech republic will be presented. Each of the 3D visualizations was based on a different set of input data and it is so clear that the creation of computer reconstructions of archaeological situations involves a lot of variables, whether due to the chronological classification of the sites or the extent of their archaeological survey. The creation of these reconstructions is mainly a problem of the imagination of the past and it will be discussed what role the integration of available information and various analogies actually play and what is the part of the imagination of the model maker, which significantly influence the resulting form of the digital model and its historical accuracy. So it is obvious that the more we go deep into the past, the more we depend on the knowledge of the whole context and less on the knowledge of specific realities. Lecture will therefore as well present how to graphically visualize the level of confidence of archaeological 3D reconstructions.

Relevance for the conference: Contribution will present different approaches for visualisations of CH 3D using computer modelling.

Relevance for the session: Contribution focus is to show level of uncertainty during the proces of creation of 3D virtual CH reconstructions.

Innovation: 3D reconstructions ranging from the paleolithic to medieval period and made all by one author provide a solid data base for discussion of historical relevancy of virtual models in archaeology.

References:

- Kantner, J. 2010: Realism vs. reality: creating virtual reconstructions of prehistoric architecture. BAR International Series 843, 47 – 52.
- Tasič, N. - Novakovič, P. - Horňák, M. (eds.) 2017: Virtual Reconstructions and Computer Visualisations in Archaeological Practise, CONPRA Series Vol. IV, Ljubljana.

Vladan ZDRAVKOVIC, Serbia

Developing and maintaining of the long-term 3D Visualization Projects - Caričin Grad – Justiniana Prima

Keywords: Visualization, Architecture, 3D, digitization

Abstract: For more than two decades software for multimedia allows experts of various fields to dive into re-creation of the disappeared historical places and various monuments of the past. The quality of work has been in all times thoroughly scrutinized by the audience, especially by the scientific community which is righteously sensitive about everything regarding approach to the work, elaboration according to the scientifically data at disposal and finally result from which an proper perception of the monument depends. In that way there is no hiding place for the expert(s) whose knowledge and skills are exposed in 3D Restitution of the architecture, either as an individual edifice or as an urban agglomeration. The question of acceptable quantity of “intelligent assumption” and percentage of

“hypothetical ideas” will remain omnipresent, meaning that it could not be generalized by numbers but rather reconsidered from project to project, from one monument to another.

The experiences gathered in five successive projects conceptualized as 3D Architectural studies for the late-antique city of Caričin Grad - Justiniana Prima in Serbia and achieved since 2002 to 2018, within the Institute of Archeology in Belgrade, have embodied several premises that could serve well or at least contribute as a guidance in further development of digitization of ancient architecture as a hybrid archaeological and architectural discipline. These premises varies from case to case, depending of the researching concepts, if work on 3D re-creation follows the archaeological investigations or not, are projects of 3D visualization conceived as a tentative study of different possibilities based on so far achieved data or as an attempt in comparative architectural analyses, etc. As summarized 3D Architectural study, Project for Caričin Grad demonstrate an changing methodology in approach which has evolved in last fifteen years, following new archaeological findings and progress achieved through interdisciplinary researches. 3D Re-creation of this early-Byzantine town, offers therefore insight into deferent stages of building of the capital, hard 3D Reconstruction of the town with all fluctuation of the quality of work and expertise as unavoidable part of such long-term project. Simultaneously, premises that could be extracted from this experience would refer to achieving of the several different stages of project where each stage targets its own audience or purpose - evolving or study model, clarified scholar documentation and promotional – public scientific material.

Relevance for the conference: 3D Visualization of the archaeologically researched monuments of the past

Relevance for the session: Sharing the experiences gathered in 15 years duration of projects of 3D Visualization

Innovation: suggesting guidance lines in further dealing with 3D Visualization of ancient monuments

References:

- 3D Visualization of cultural heritage, scientifically validation of 3D Reconstruction

Denis ZHEREBYATYEV | Svetlana BORISOVA | Sergei KARTASHOV | Ivan TRISHIN | Danila DRIGA | Maxim MIRONENKO, Russia

Traditional methodology of excavation, preservation and reconstruction culture heritage objects are needed to new methodology such as BIM, laser scanning, photogrammetry, UAV, GIS, Data Base, and so on. Only collaborate with traditional methodology of humanitarian research and a new IT technology is possible to look at cultural heritage from a different angle and find new data. UNESCO culture heritage objects such as St. George's Cathedral in Russia more than other object are needed to digitalization and analytics.

The white-stone St. George's Cathedral is one of the famous monuments of the pre-Mongolian stone architecture of Vladimir region (Russia) of the 13th century, its architectural history dates back more than six centuries. All the facades of the temple were covered with white-stoned carved images of the saints, animals, chief's family and mythical creatures. Throughout time, the unique shape of the cathedral and its carved stories were lost when in the 15th century the cathedral collapsed. For several decades it was rebuilt, became lower, lost its original proportions and its unique ornament.

With the destruction and subsequent reconstruction, some parts of the stoned story were lost and damaged.

This fact created additional difficulties for reconstruction of its original appearance. Modern technologies like laser scanning, photogrammetry, 3D modeling programs and building information modeling BIM and CAD open new perspectives for reconstruction of the original shapes of the cathedral and the lost ancient plots, as well as checking the existing hypotheses of the cathedral reconstruction.

Relevance for the conference: Traditional methodology of excavation, preservation and reconstruction culture heritage objects are needed to new methodology such as BIM, laser scanning, photogrammetry, UAV, GIS, Data Base, and so on. Only collaborate with traditional methodology of humanitarian research and a new IT technology is possible to look at cultural heritage from a different angle and find new data. UNESCO culture heritage objects such as St. George's Cathedral in Russia more than other object are needed to digitalization and analytics.

Relevance for the session: Modern technologies like laser scanning, photogrammetry, 3D modeling programs and building information modeling BIM and CAD open new perspectives for reconstruction of the original shapes of the St. George's Cathedral and the lost ancient plots, as well as checking the existing hypotheses of the cathedral reconstruction in the XIII century.

Innovation: During research the stone reliefs of St. George's Cathedral were digitized by using photogrammetry, UAV and 3D scanning technology. To combine a large number of stone reliefs in Unity 2018 a computer program was developed. As a result, several lost biblical and mythical subjects were reconstructed.

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- Modern information technologies in the task of preserving the historical and cultural heritage: 3D, laser scanning, photogrammetry, aerial photography, etc. URL: <http://www.hist.msu.ru/YoungLeaders3D>
- Saint George Cathedral, Yuryev-Polsky. URL: https://en.wikipedia.org/wiki/Saint_George_Cathedral,_Yuryev-Polsky
- Creating a digital library of 3D-models of architectural décor of pre-Mongol Rus for the virtual reconstruction of St George's Cathedral, Yuryev-Polsky / International forum "Virtual archaeology – 2018, SPb. URL: http://virtualarchaeology.ru/pdf/318_va_pro1003.pdf

Locative media and heritage engagement in pre-modern urban environments

Chairs: Fabrizio NEVOLA | Cristina MOSCONI, University of Exeter, UK

Digital technologies enable a novel form of research-based engagement with the historical palimpsest of the urban fabric. Within the context of the wider humanities preoccupation with the 'spatial turn', digital tools have afforded researchers new approaches for both research and user engagement through the development of new interpretative methods delivered through locative media technologies. Such approaches – delivered in a variety of forms including apps and web apps, some of them employing elements of augmented reality – have been applied to the exploration of a variety of heritage environments, especially of historic urban areas. This session invites papers that present either comparative or case-base examples, although we would invite all presenters to frame these through analytical consideration of such practices and methods.

Papers might consider:

- how do locative media enable place-based visualisation of tangible (e.g. texts, books, images, objects and performances) and intangible heritage, offering alternative means of recording, archiving and experiencing these?
- how does a consideration of the user experience alter research questions and indeed the research practices of academic Researchers?
- what kind of research topics are inspired by designing a locative application?
- what tensions may emerge between the imperatives of location-based user experience design within the urban fabric, research-led processes and the needs of heritage organisations to deliver public-facing locative Interpretation?

Georgios ARTOPOULOS | Constantinos MILTIADIS, Austria

The visual imaginary of intangible cultural heritage: accessing the palimpsest of Nicosia through audio-enabled routes

Keywords: intangible cultural heritage, audio-enabled routes, locative media, spatially-distributed narratives

Abstract: This paper presents theoretical and practical considerations regarding the role of moat of the medieval walls of historic Nicosia, the last divided capital of Europe. The moat acquired an important role for Nicosia when the city started expanding beyond the medieval footprint of the labyrinthine urban fabric of the historic core during the late period of British rule on the island. After the war of 1974 and the division of Nicosia, the urgent and ever-growing needs of the city for empty plots to support its infrastructure and operation led to the fragmentation of the moat.

In response to this need it discusses new approaches to the use of Information Communication Technologies (ICT) for facilitating the re-appropriation of the moat from being used as parking space, and other fragmentary private uses, into a green belt that highlights the only shared heritage that unites the two sides of the divided city, that is, its Medieval Walls. In particular an ICT-enabled initiative is presented that involves the creation of spatially-distributed storytelling for the promotion of the history of the Medieval walls of the city by exploiting the software and communities of Geocaching

driven by preliminary results of a survey of users of the public space of the moat. The organization of this initiative was supported by a H2020 COST Action (TU1306) Short Term Scientific Mission, the results of which will be presented in the paper.

Concluding, the paper presents a grassroots approach to the application of digital interfaces, which contributes to the exploitation of heritage in Mediterranean cities for the reactivation of neglected urban green spaces through playful engagement and storytelling. Employing a format of locative, historically corroborated dramatized audio narratives, this initiative intends to provide an experiential approach to history, eventually aiming to trigger the audience's visual imaginary over their immediate surroundings.

Relevance for the conference: The paper suggests the use of a "cloud" layer over the city, on which to collect and expose the multiple narratives of its dense historical past, functioning therefore as a neutral ground for the analysis of the city's historical palimpsest.

Relevance for the session: Employing a format of locative, historically corroborated dramatized audio narratives, the initiative intends to provide an experiential approach to history, eventually aiming to trigger the audience's visual imaginary over their immediate surroundings.

Innovation: The paper presents a grassroots approach to the application of digital interfaces and historic narratives, which contributes to the exploitation of heritage in Mediterranean cities for the reactivation of neglected urban green spaces through storytelling.

References:

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Wouter BRUIJNINCKX, Belgium

Communicating the Historical and Architectural Context of Heritage Environments Using Augmented Reality

Keywords: Augmented reality; heritage environment; communication; architectural context

Abstract: Understanding the spatial and aesthetic transformations of spaces, decoration and materials over the time is one of the important heritage challenges. Communicating this information is not only necessary for documentation and conservation purposes, but it also corresponds to raise community awareness and to enable heritage visitors to appreciate heritage buildings and sites in more experiential ways. With the rapid evolution of digital technologies, museums and heritage environments started to incorporate Augmented Reality (AR) to present and interpret heritage artifacts in more appealing and exciting ways. AR allows both an enrichment of heritage communication, and also encouragement of interactivity in heritage environments. Through a field study in a real-world heritage environment, we investigated how AR enhances the communication of the original context of the chapel of Arenberg Castle in Belgium. We deployed a mixed-method evaluation methodology that aimed to communicate the original architectural context of the chapel and to increase engagement and memorability of heritage visitors. Our results show how visitors were able to realize and to recall

salient architectural features and spatial dimensions of the chapel during the sixteenth century. We conclude the paper with a set of discussion points about how AR positively affects visitors' memorability of architectural qualities, and how it provokes their curiosity to explore more information. We highlight some considerations about AR visualization, such as how the colorful details draw visitors' focus of attention, and how heritage uncertainty should be visualized in AR applications.

Relevance for the conference: Enabling heritage visitors to appreciate heritage buildings and sites in more experiential ways

Relevance for the session: Through a field study in a real-world heritage environment, we investigated how AR enhances the communication of the original context of the chapel of Arenberg Castle in Belgium

Innovation: Our results show how heritage visitors were able to realize and to recall salient architectural features and spatial dimensions of the historical chapel during the sixteenth century

Ana PLOŠNIĆ ŠKARIĆ | Natko KATIČIĆ, Croatia

An Example of Map Searchable Database: Dubrovnik City Councils' Deliberations 1400-1450

Keywords: map searchable database, archival documents, urban history

Abstract: The aim of this paper is to present and discuss an example of the map searchable database that contains full transcriptions of previously unpublished archival material.

There are thirty-five volumes (7972 folia, i.e. 15,944 pages) kept at the Dubrovnik State Archives that contain the deliberations of the three city councils of Dubrovnik (the Major Council, the Minor and the Senate), from the first half of the fifteenth century. From these volumes, all the deliberations concerning urban space and its buildings are systematically collected and transcribed. Instead of just publishing these 3362 deliberations (app 1,5 million characters) as a book, an effort was made and the map searchable database was established at the website (<https://ducac.ipu.hr/project/mapping/>). This database is meant to facilitate further in-depth research on Dubrovnik urban development.

First, we would present the programming within Wordpress that supports the database; second, the issues we were facing while mapping late medieval data, and the third, a case-study made by using the database, presenting possibilities for further in-depth research. It is the case of a slaughterhouse and butchery, situated in Dubrovnik port. Due to the preserved city councils' deliberations, it was possible to present its development in 3D schematic models.

This work was done within the project "Dubrovnik: Civitas et Acta Consiliorum. Visualizing Development of the Late Medieval Urban Fabric" (DUCAC), that was conducted at the Institute of Art History, Croatia, and funded by the Croatian Science Foundation.

Relevance for the conference: digital urban history

Relevance for the session: web application

Innovation: map searchable database of previously unpublished fifteenth-century documents

References:

- Danko Zelić, Ana Plošnić Škarić (eds.), *Dubrovnik: Civitas et Acta Consiliorum 1400-1450*, Zagreb: Institut za povijest umjetnosti, 2017.

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Gerhard SINDELAR, Austria

Effects of technology and marketing on app concepts for cultural heritage organisations

Keywords: app concepts, native or hybrid

Abstract: Smartphones fundamentally change the behavior of users. The result is new formats such as apps, web apps, 3D, virtual and augmented reality for mobile devices. Locative media provide access to historical objects that are normally only accessible to researchers. Location-based visualization means that access and availability are greatly expanded. This requires concepts of what content and how it is offered with locative media. In cultural heritage organizations exist little knowledge of the technology of locative media. As a result, there can be found solutions which offer limited availability of content and inefficient presentation. Another problem area is detected in intuitively functioning user interfaces. Examples show how lack of technical know-how leads to expensive and inefficient solutions. The success of integrating digital solutions to represent Cultural Heritage depends on some factors: choice of appropriate technology, cross-platform, barrier freedom, internet visibility and marketing features. Hybrid forms of apps, which in certain areas, such as navigation via online maps or downloading content need access to the internet, therefore rapidly reaching their limits with regard to availability and function. State of the Art is the implementation of interactive 360° VR, 3D, virtual and augmented reality as well as offline GPS navigation. The locative media open up a range of research fields: How are scientific texts transformed into a generally understandable language? Which forms of interactivity can be provided in locative media beyond conventional social media applications? How can cultural heritage organizations refinance themselves with locative media? What role can tourism companies play in marketing and sales? What role does edited content play for users? What demands do new trends like interactive VR and AR make on research, such as: the visualization of lost buildings based on plans and historical views? Topics and problem areas listed above are shown and discussed.

Relevance for the conference: presentation and analysis of app solutions in the field of cultural heritage

Relevance for the session: effects of new technologies on the research landscape concerning cultural heritage

Innovation: app technology used as marketing instrument by integration of local touristic players

References:

- App Hofburg Wien, App and 360°Teaser Baden: <http://beyondarts.at/app/baden-vr/de/>

The Employment of Mobile Applications

Chair: Claudiu SILVESTRU, Austria

The wide access to “smart” mobile devices as well as the easiness of mobile application distribution through several webstores have led to an inflation of apps. A major factor for the high popularity is the permanent availability and intuitive use through user owned – i.e. already well known – handheld devices of everyday life.

From gaming to text editing and training to navigation, mobile applications are common in all imaginable fields – including building and urban history and addressing often at the same time professionals and the general public. Apps are employed in presentation and interpretation strategies by e.g. museums as well as in scientific research like urban archaeology and building survey.

The rapid development in the field of apps leads to several issues to be addressed especially when using them for information, education and research purposes, such as:

- Origin of data and information: Especially considering the openness of app stores and the inflation of apps its becoming increasingly difficult to sort out solid third party apps for infotainment.
- Copyright and pricing: Pricing models as well as copyright issues due to the light version / full version differences affect research projects especially if the target is to use free – or even open source – software only.
- Funding, retail and update: Public funding generally requires not for profit projects which don't generate additional income. Apps– and especially scientifically validated research, database or information software – need to be updated periodically in order to meet the requirements of new “smart” mobile devices as well as to implement new research findings.

This session's aim is to discuss the challenges and promises of the current and future development and implementation of mobile apps in urban archaeology, building survey and urban history research.

Gabriele GATTIGLIA | Francesca ANICHINI | Michael REMMY | Holly WRIGHT | Massimo ZALLOCCO, Italy

A mobile app for the automatic recognition of archaeological potsherds: the ArchAIDE project.

Keywords: Deep Learning, image recognition, shape recognition, Archaeology, Ceramic

Abstract: Pottery is the most common archaeological evidence and is of fundamental importance for the comprehension and dating of archaeological contexts, and for understanding the dynamics of production, trade flows, and social interactions. Today, classification of ceramics is a time-consuming activity carried out manually, through the expertise of specialists and the use of analogue catalogues held in archives and libraries. The ArchAIDE project (2016-2019) is funded by the European Union's Horizon 2020 research and innovation programme and aims to create a new system for automated recognition of archaeological pottery with an innovative app designed for tablets and smartphones, without changing the current overall approach and reasoning process of the archaeological community. Ceramic fragments can be photographed, their characteristics sent to a comparative collection, which activates an automated object recognition system, resulting in a response with all relevant information linked to the image of the fragment.

Deep learning algorithms have been developed for classifying pottery, both through decoration and profile. Using appearance-based and shape-based recognition, neural networks have been trained with synthetic data and more than 13.000 images of real potsherds. This process has informed the design of a reference database for pottery types, decorations and stamps to be used as comparative target by the classification tools. It has also resulted in the development of advanced OCR tools for the digitisation of paper catalogues, the automated of extraction of 3D models from 2D drawings, and the creation of a corpus of thousands of classified pottery sherds to refine the neural network training. Currently, ArchAIDE app is a proof on concept, working with catalogues related to the Terra Sigillata (Italica, Hispanica, South Gaulish), Roman Amphorae, Italian Majolica of Montelupo, and Spanish medieval and post-medieval majolica from Barcelona.

Relevance for the conference: The app is especially created for supporting archaeological professionals and researchers during fieldwork such as urban excavations and development led archaeology.

Relevance for the session: The paper deals not only the technical aspect but also issues of paramount importance in the archaeological domain such as copyright management, open data and exploitation plan.

Innovation: The automatic recognition of archaeological potsherds represents an innovation by itself and having it at your fingertips through a mobile application is even more innovative.

References:

- BANTERLE, F., DELLEPIANE, M., EVANS, T., GATTIGLIA, G., ITKIN, B. and ZALLOCCO, M. 2017. The ArchAIDE Project: results and perspectives after the first year. In R. SABLATNIG and B. ŠTULAR (Eds.) EUROGRAPHICS Workshop on Graphics and Cultural Heritage, pp. 161-164.
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Marco MONTANARI | Lucia MARSICANO, Italy

CHContext - easing the creation of GIS readers

Keywords: generator, gis, app,

Abstract: In a given context and within a specific ruleset the needs of users and administrators are very similar or can be reconducted to a similar set of elements. From this premise stems the work on the GeoContext Platform, which enables users to interconnect geographic information and observe it in a shared context collector where all the info the user might need are geographically contextualized whatever the sources.

Most of the current contextualizations done with GeoContext have been defined for Cultural Heritage institutions or for public administrations delivering Cultural Heritage content. For those institutions the previous sentence has even more value: By definition the requirements of such an institution can be simplified and analyzed in a completely abstract manner. For this reason the work of GeoContext has

proven so valuable, being a convergence platform where content and form can be merged into simple and standardized interactions the users can expect from the several other applications already available on the various app stores.

The CHContext application generator is a tool using GeoContext for the autonomous creation of web and mobile applications that enable museums, ecomuseums, and archaeological parks to expose their georeferenced data through simple standardized interfaces with a unique and simple user experience.

Relevance for the conference: industrializing the cultural heritage process enables the elevation of standards.

Innovation: The innovative approach to the problem of cultural heritage application creation stems from the industrialization of the application definition process

Claudiu SILVESTRU, Austria

CultApp - Apps for Mobile Devices for the Interpretation of Cultural Heritage Sites in Vienna

Keywords: Apps, Vienna, Cultural Heritage Interpretation

Abstract: Austria and especially Vienna have a vast offer of cultural heritage sites building up one of their main touristic marketing lines. Nevertheless, there are currently no studies on the offer of apps for cultural heritage sites in Austria. International examples of research and studies from the European area are sporadic. In this context, the overall objective of the project CultApp is to synthesize an overview of the currently available apps for the interpretation of cultural heritage sites in Austria and to provide a solid foundation for further research on smart device applications supporting the creation of better cultural heritage apps.

The paper at hand focuses on available apps for Viennese cultural heritage sites. In doing so it addresses questions like: What types of apps are used to interpret both high- and low-profile sites? or What development tendencies can be recognized? The applications are evaluated and compared on the basis of three sets of criteria: content – including origin, actuality, narrative thread – handling – including graphic design, interactivity, multilingualism - and costs.

The results of the evaluation are summarized in an overview of qualities and deficits. Summing it up, the relationship between qualities and deficits on the one hand and the size of the cultural heritage site, the app provider and the managing body of the site on the other hand is analyzed.

Relevance for the conference: The paper focuses on the use of new digital media for heritage interpretation.

Relevance for the session: The paper deals with the strong contrast between apps gaining importance as interpretation media and the quality of the currently available apps.

Innovation: The paper presents a first overview and analysis of available apps for heritage interpretation in Austria.

References:

- Daniel R. Stiller, Willem Beex , 2017. Apps under the surface. Problems with Cultural Heritage apps , SDH, 1, 2, 326 - 343 .

Gabriel WURZER | Hans RESCHREITER | Fiona POPPENWIMMER, Austria | Jiri UNGER, Czech Republic | Christoph LOBINGER | Christiane HEMKER, Germany

Producing location-based heritage apps using only a ZIP file

Keywords: Location-based cellphone apps; app production; web technologies

Abstract: The technical divide between app producers and archaeologists has led to a situation in which publication of heritage on mobile devices is hindered by lack of funding: Programming an app is expensive; keeping the content up to date furthermore requires regular updates which add up to the running costs.

In our work for the EU Project VirtualArch, we have thus sought a way in which archaeologists can cross this technical barrier and produce a location-based App without need for programming or external consultancy.

In more detail, we have produced a portal which allows the upload of a zip file containing a range of media (images, text, 3D files, panoramas, movies) in one or more folders; each one is transformed into a points of interest on a map for which the associated media can be shown as a slideshow. The key strength of the approach lies in the fact that the portal can produce both web presentations as well as apps using the same content. Technically this is achieved via the use of rules for transforming the content into html/css + javascript, and Apache Cordova / Adobe PhoneGap for turning the resulting web page into an app.

Since archaeologists are perfectly capable of producing content, they can now disseminate their work frequently to a wider public, without being hindered by technological and/or financial barriers. Our portal is open-source, allowing a wide range of disciplines who are occupied with location-based presentations (e.g. also tourist offices, festivals etc.) to benefit from our proposed approach.

Relevance for the conference: This contribution enables to produce a location-based heritage app without needing to program

Relevance for the session: We present a "from zip to app"-workflow as a main contribution and discussion point among the session

Innovation: Transforms a folder + file hierarchy into a location-based app

References:

- E Dobat, S Walkshofer & C Flügel (2013): 'Mainlimes Mobil: Presenting Archaeology and Museums with the Help of Smartphones', in Nigel Mills (Ed.), 'Presenting the Romans: Interpreting the Frontiers of the Roman Empire World Heritage Site', Heritage Matters 12, Boydell & Brewer and Boydell Press, pp. 103-112. see online: <https://www.jstor.org/stable/10.7722/j.ctt31nhq2>
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PhD/Master session 2018

Chair: Martina POLIG, Cyprus

At a large congress like the “Visual Heritage 2018” which brings together communities from different fields and areas of expertise to share and discuss experiences and methodologies it is important to give also space to the new scientific generation. Students and recent graduates are encouraged to contribute with their ongoing or finished Master or PhD thesis at this federated event. Their participation will enrich the scientific ambient with their fresh views as well as give them the opportunity to confront themselves with their peers in the context of an international conference. The topic of the presentation should be within the scope of the congress and cover the digitization of Cultural Heritage, the analysis and management of the digitized data as well as its visualization. New ideas, new ways of thinking, clever solutions, workarounds and critical thoughts are especially welcome.

The session wants to encourage young scientists to present for their first time at an international conference.

Leticia CRESPILO MARÍ, Spain

New didactic strategies: 3D modeling and Virtual Reality as a cataloguing alternative of light environments and their application in museums and Art History classrooms

Keywords: teaching strategies, 3DModelling, Virtual Reality, Art History, Light Environments

Abstract: The new interactive digital aesthetic has replaced the traditional "subject/artwork" relationship with a new conceptual vision "user/artwork" where the participation of the subject becomes important. The presence of light as an aesthetic resource configures hybrid, performative, participatory, de-temporalized and disruptive spaces that require deep reflection as a subject. Virtual Reality will allow us to propose an alternative prototype of cataloging of light environments. The theatrical dimension of these interventions is the key, because we speak of a tool that amplifies communication through access to referential worlds based on reality. This approaches us to this type of manifestations, helping us to understand and experience these sensations through 3D models. These strategies of representation allow us to value these spaces, learning directly in a simulated environment in which the physical body becomes a priority element.

In this research, a reflection and application work is developed with practical cases from the perspective of the philosophy of art and aesthetics (50 artists selected and their works). In them we can observe the displacement of the artistic object to the idea: aesthetic dimension, experience and perception of the subject. In addition, its reception, dissemination and research within the museographic practice is analyzed. This will allow us to examine its discursive, philosophical and theoretical content.

The aim is to increase the value of this type of intervention by proposing a cataloging alternative that improves the reception and production of knowledge of these interventions. This is an interdisciplinary project that uses 3D visualization and Virtual Reality, tools of the current immersive and interactive strategies of the new Vanguard Museography, and proves to be very useful for its accessibility and didactic value in the field of heritage dissemination in museums and classrooms.

Relevance for the conference: This alternative of 3D cataloging can allow rethinking the accessibility of contents and its conservation for future generations

Relevance for the session: developing architectural spaces through softwares and interfaces that allow the subject to enter in three-dimensional spaces which the traditional catalog couldn't make accessible, in order to create a total knowledge about this kind of interventions

Innovation: stimulating discourses that encourage the acquisition of new knowledge through the Avant-garde museography

Yannick DE RAAFF | Theo VERLAAN | Sofia VOUTSAKI | Gary NOBLES, The Netherlands

Destruction, Construction and reconstruction: the Built Chamber Tomb of the North Cemetery at Ayios Vasilios, Lakonia

Keywords: 3D Virtual Reality Tomb architecture

Abstract: This study is concerned with the reconstruction of the architecture of a so-called Built Chamber Tomb found in the early Mycenaean cemetery of Ayios Vasilios, mainland Greece (approx. 1700-1420 BC). The Built Chamber Tomb is a rather rare tomb type that signals some of the first architectural elaborations on the mainland and they are testament to a change in funerary practices and beliefs. At the same time pervasive social changes take place with the appearance of social differentiation.

The main topic is the reconstruction, construction, multiple use and destruction of a partially preserved tomb called Tomb 21. The architecture of this particular tomb – especially the roof – is uncertain. This is because this tomb was introduced in a process of experimentation: tomb 21 is both larger and more labour intensive than the surrounding tombs and built for multiple burials. This has major repercussions for the construction of the roof. At least 25 individuals have been buried inside Tomb 21 at different times, which means the tomb was repeatedly opened and closed with every single interment. The roof was clearly not a simple closing mechanism never to be touched again, it was the most dynamic part of the construction.

The goal of this study is to understand both how the tomb collapsed and how it was originally constructed. To do so, we use a number of digital techniques, such as photogrammetry and Virtual Reality. In cooperation with the Virtual Reality/Augmented Reality Center of the University of Groningen we create a digital environment in which it is possible to 'puzzle' back together the various pieces and create a number of scenarios and reconstructions. This allows us to gain a better understanding of the sequence of actions that have taken place inside the tomb. This project is also used to train students in the possibilities and application of photogrammetry, 3D modeling and VR techniques. The reconstructions themselves will be used for heritage purposes, in order to visualize the process of experimentation with new mortuary practices and to present the process of social differentiation to the public.

Relevance for the conference: We offer an application of a combination of both photogrammetry, 3D modeling and virtual reality for research purposes (understanding sequences of action, innovation, experimentation) that can be used to teach students of the University of Groningen the basics of digital techniques, and the visualisations and immersive character of the application can be used to explain highly sophisticated and intricate scientific discussions to the public.

Relevance for the session: The lead speaker is involved in this project as research assistant to Prof. Sofia Voutsaki, which makes this session a good opportunity to practice with presenting papers at conferences, while at the same time we hope to present a clever and innovative application of digital techniques.

Innovation: The innovation is mostly related to the combined application of photogrammetry, 3D modeling and Virtual Reality techniques in order to explain the complex archaeological situation, an innovation which has up until now been almost entirely absent in the field of Aegean Bronze Age archaeology.

References:

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H. Kübra GÜR DÜZGÜN | Emre BEDEL, Turkey

Stratification in urban archeology: Marmaray Project Sirkeci Station Rescue Excavations

Keywords: Urban archeology, GIS, Multi-layered, Istanbul, rescue excavations

Abstract: The PhD thesis is about the architectural stratification of the Sirkeci Station of Marmaray Project which is one of the most important rescue excavations in the Historical Peninsula of Istanbul. These excavations, which were held under the authority of Istanbul Archeological Museums in 2004-2012, are assessed as an example of urban archaeology. Also, archaeological inventory is discussed with new visualization and documentation methods.

A project called "Implementation process of the architectural data of Marmaray Sirkeci Excavations on GIS to interpret the stratification in an example of urban archaeology" is prepared for the thesis. The first aim of the study is to establish a digital archive in GIS for further research of Sirkeci. Another important aim and benefit of this study is the creation of the ancient topography of the area with the help of GIS. The GIS database is created by attaching every architectural layer to the system with x,y,z coordinate as a part of the archaeological inventory, and by transferring their features to the database with the attribute table containing all related data. Spatialization of the layers with coordinates is interpreted in the context of urban archaeology.

There were four sites in the excavation: south station, north station, east shaft and west shaft. The sample area for this presentation is the east shaft to explain how to use the GIS database for the thesis. It is thought that the topographical change of the area is showcased better in this sector due to the sea level differences in this part, which are used to redefine the stratification of the area. All architectural drawings of the site which were visualised as dwg files during the rescue excavation, are evaluated to understand architectural structures and their relationship to the urban pattern with this thesis. The new database of Sirkeci excavations in GIS is an important step not just for the thesis, but also for urban archaeological works being held in Istanbul.

Relevance for the conference: The Phd thesis is focused on a very important cultural heritage site of Istanbul with a huge amount of data which will be examined by using the new technology's opportunities in a GIS project.

Relevance for the session: This is an on-going Phd project with an important potential

Innovation: Using the raw excavation material to create an ancient topography.

References:

- Prof. Christine OZGAN
- Ass.Prof. Zeynep ERES

David Frederik HÖLSCHER, Germany

Communicating current research content through multimedia learning environments. Insights into a joint university and Leibniz Gemeinschaft research project from Kiel

Keywords: science communication, didactic research, environmental archaeology, social archaeology, gamification

Abstract: Archaeological topics and research are brought to the public's attention by many formats. Among the most important are exhibitions and educational programmes in museums as well as radio and television broadcasts. In the course of rapid technological development, especially in the digital sector, multimedia formats have also been included in informal learning settings. Yet the actual didactic benefits of these formats are rarely evaluated. The goals of the PhD project "Knowledge transfer in archaeology. A study on the communication of current research content through multimedia learning environments" (working-title) are twofold: On the one hand, it aims at communicating historical dimensions of human-environment-interactions and social development to the public. In order to achieve this, a multimedia learning environment related to research in landscape and social archaeology at Kiel University will be developed. On the other hand, the learning process will be studied from a didactic perspective in order to investigate the learning outcome of this specific educational programme.

The multimedia tool will utilise advantages of informal learning environments such as explorative, self-steered and experience-based learning, as well as their technical support, e.g. through digital "gamification".

The project combines a practical educational opportunity in Archaeology, didactic theory and didactic research in a way currently unique in the discipline.

The project started in January 2018 and is embedded in the Kiel Science Outreach Campus (KiSOC), which was formed as joint project of Kiel University and the Leibniz Institute for Science and Mathematics Education.

Relevance for the conference: One aim of the project is to produce a multimedia tool for the communication of archaeological content with an on-site approach.

Innovation: The projects approaches the communication of archaeology on basis of didactic theories and combines it with didactical research on learning outcomes.

References:

- L.R. Andersen/T. Møbjerg, "Digital Threads across the Landscape" –a smartphone application co-developed by users. *Archäologische Informationen* 36 (2013) 45–53.
- H. Düselder/A. Schmitt (Hrsg.) *Umweltgeschichte: Forschung und Vermittlung in Universität, Museum und Schule* (Köln [u.a.] 2014).

Naoki MORI | Tokihisa HIGO | Kaoru SUEMORI | Hiroshi SUITA | Yoshihiro YASUMURO, Japan
Visualization of the Past-to-Recent Changes in Archaeological Heritage based on 3D Digitization

Keywords: Investigation history, (SfM) Structure from Motion, PnP Problem

Abstract: This paper is motivated by work at “Barbar Temple,” which is one of the significant archaeological sites in the Kingdom of Bahrain. This site dating back to the 3rd millennium BCE belongs to the ancient Dilmun civilization which has a relation with the Mesopotamian and Indus civilizations. This remarkable site has been required to protect and listed on the Tentative List of UNESCO World Heritage. The documentation of Barbar Temple has been started since the first excavations by Danish mission in the 1950s -1960s. There is a possibility to grasp the changes and damages of the site caused by environmental or human factors over the decades by utilizing the photographs taken in the past. As a case study to apply 3D digitalization for protecting the archaeological site, this paper proposes a methodology for collation of the ‘past photographs’ and current physical appearance. The process of this method consists of three steps; 1) estimate 3D position and the orientation of the camera by which ‘past photographs’ were taken; 2) make corresponding pairs between ‘past photographs’ and the 3D data of current site; 3) render a CG model of the current site from the viewpoint of the estimated camera position and orientation; 4) overlay the CG with the ‘past photographs’ on the same view. This paper applied the method to the ‘pool’ area of Barbar Temple, which was a pivotal facility of the temple with a sacred spring used for worship of Sumerian water god Enki. It was expected that the piled-up blocks of the stone construction surrounding the spring has caused strains on itself and changed its appearance. This methodology enabled us not only to grasp the changes in the whole appearance of this area easily but also to find the slight changes in the orientations of the stones quantitatively.

Relevance for the conference: Our work aims to develop a methodology of using 3D digital reconstructions as research tools to associate the old photo records to the current as-is information of the archaeological site.

Relevance for the session: The first author is a master course student in graduate school of Science and Engineering.

Innovation: This paper addresses a methodology to support the collation of photo data taken in the past and the current presence by image processing.

References:

- P. Rodríguez-González and A. L. Muñoz-Nieto and S. del Pozo and L. J. Sanchez-Aparicio and D. Gonzalez-Aguilera and L. Micoli and S. Gonizzi Barsanti and G. Guidi and J. Mills and K. Fieber and I. Haynes and B. Hejmanowska, 4D RECONSTRUCTION AND VISUALIZATION OF CULTURAL HERITAGE: ANALYZING OUR LEGACY THROUGH TIME, ISPRS - International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. XLII-2/W3, pp.609-616, 2017.

- B. Hejmanowska, E. Głowienka, P. Opaliński, S. Mikrut, K. Michałowska, and P. Kramarczyk, "4D Reconstruction and Visualisation of Krakow Fortress," in 2017 Baltic Geodetic Congress (Geomatics) : proceedings of a meeting held 22-25 June 2017, Gdansk, Poland., pp. 1–5, 2017.

Jasmin SCHEIFINGER | Barbara RANKL | Iulian GANCIU, Austria

The archaeological, conservation and heritage story of Ephesos. Visibility and representation

Keywords: Geophysical prospection, Restoration, UNESCO-World Heritage site, Ephesos

Abstract: This presentation will provide an insight into a research project funded by the Austrian Academy of Sciences. The project is carried out as cooperation between three research institutes in Vienna: The Austrian Archaeological Institute, the Institute of Conservation and Restoration at the University of Applied Arts Vienna and the Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology.

The ruins of Ephesos were never completely covered by soil, and since their rediscovery extensive research and rebuilding activities have been carried out. The UNESCO-World Heritage Site not only attracts millions of visitors every year but also represents an important centre of archaeological, conservation scientific and heritage study research.

The current study deals with overarching research questions from the perspectives of archaeology, conservation science and cultural heritage studies. Three doctoral studies interlinked to one interdisciplinary project will interpret the image of Ephesos as it is presented today and show how and why it changed over the course of its long period of research.

The archaeological study focusses on the archaeological interpretation of geophysical prospection data. By digitizing the data, a new analysis and visualisation of the urbanistic development of the ancient city shall be carried out.

The conservation scientific study deals with the history of restoration and the rebuilding activities in Ephesos. This part of the interdisciplinary project will investigate the transformation of the city from a natural landscape with ancient ruins to an archaeological park utilized by mass tourism.

The cultural heritage study will examine the impact of a world heritage site on the daily life of the local community. It explores the effects of cultural heritage on processes of local identity formation and on the meanings attributed by local people to the site's cultural heritage.

Relevance for the conference: The project focusses on the visualisation of hidden remains underneath the earth and its joint interpretation with the visible heritage in Ephesos.

Relevance for the session: Within the session we would have the opportunity to present and discuss our topic with a broader audience and experts of different fields.

Innovation: The output of this interdisciplinary project is able to fill in a gap in understanding the construct and agency of Ephesos, this way the ancient life history of this ancient site will no longer be disconnected from that of the archaeological park, but rather be understood as an artistic synthesis.

Michael TEICHMANN, Germany

Quantitative Analyses of Roman Settlement Patterns in Southern Latium

Keywords: Roman Landscape Archaeology, Settlement Archaeology, GIS, Site Location Modelling, Latium

Abstract: The present paper applies quantitative analyses to improve our understanding of Roman extra-urban settlement patterns in southern coastal Latium. Records for more than 5000 archaeological sites were gathered from publications and archives in a GIS database for the region between the Tiber, the Alban hills, the Lepini and Ausoni mountains, Terracina and the Tyrrhenian Sea. The study area is characterized by a variety of heterogeneous landscapes. Therefore, one of the central research questions concerns the interdependence of landscape types (as alluvial plain, coastline, volcanic hill or limestone mountain) and factors, which were decisive for locational choices. Descriptive site location analysis was conducted for site types such as “villa”, “villa rustica”, “cistern”, “tomb” and “surface find scatter” in respect to various environmental and cultural parameters, which may have influenced the choice of site locations. These factors comprise variables derived of the elevation model such as altitude, slope or exposition, background geology, soils, the cost-distance to resources (watercourses) as well as cost-distances to elements of the cultural landscapes such as roads, sanctuaries and towns.

A comparison was undertaken for different site types in the same „micro-region“ as well as for the same site type in different environmental settings. In a further step the patterns observed for the study area were compared with results of further published quantitative studies in Latium and Campania to identify similarities and differences. Additional analyses concerned site density distribution and intervisibility. The former analyses the spatial distribution of different site types in the study area, identifying hot spots of activity. The latter assesses the role of visibility for important elements of the cultural landscape such as villas, towns, roads and sanctuaries. Visibility may have been of relevance for aspects of social representation and a visual dominance of the landscape.

Relevance for the conference: The paper is relevant for the conference as methods and results are presented, which enable a better understanding of ancient settlement patterns using Digital Technologies (therefore New Technologies are used to improve our understanding of Cultural Heritage).

Relevance for the session: My PhD thesis was dedicated to the mentioned research questions. There is no particular thematic focus of this session.

Innovation: A huge amount of analog site data, was collected, digitized, reclassified and analysed with quantitative methods to create a coherent picture of the region’s site distribution in Roman times.

References:

- M. Teichmann, *Mensch und Landschaft im südwestlichen Latium in der römischen Antike* (2017);
- M. Teichmann, H.-R. Bork, *Geo- and Landscape archaeological investigations in south-western Lazio (Italy): A diachronic approach to man-made landscape transformation processes in the hinterland of Rome*, in: S. Kluiving, E. Guttman-Bond (Hgs.): *Landscape Archaeology between Art and Science. From a Multi- to an Interdisciplinary Approach*, 2012, 211-222.

Rolando VOLZONE | Federico CIOLI | Matteo BIGONGIARI, Italy

The church of St. George in the Kyrenia castle in North Cyprus, bringing out the shape of architecture

Keywords: Digital Survey, Kyrenia Castle, North Cyprus, St. George's Church

Abstract: The contribution focuses on the digital documentation of St. George's church, built in the 10th century close to the Roman fortress of Kyrenia in North Cyprus. In medieval times, the Kyrenia castle became a focal point in the defense of Cyprus. During the Crusader period and then under the Venetians and the Ottomans, the fortress has been continuously fortified, incorporating the Church of St. George within the defensive walls. A digital survey campaign was carried out in order to study the volumes and the features of the religious architecture, integrating both the morphological data from laser scanners and the data from the photogrammetric survey (Structure from Motion), which return useful information about the materials and the state of conservation. The complex distribution of spaces, of which today only the dome is visible from the outside, is understandable thanks to the development of a three-dimensional model, obtained from the digital survey, through which to create two-dimensional drawings representing plans and elevations. In fact, the geometry of the church is difficult to read from the outside, just as the fortress is not perceptible from the inside. The digital survey is therefore an interpretative tool in order to connect these two realities. The drawings are useful instruments for the interpretation and the analysis of the construction techniques. Furthermore, the stratigraphic-evolutionary study of the Church of St. George, together with a careful analysis of historical sources, allows understanding the development phases of the building in relationship with the enlargement of the castle's defensive structures. These processes allow us to return a critical and updated image of an emblematic building of the Kyrenia castle, easily usable and understandable to visitors.

Relevance for the conference: The paper deals with the consolidated technologies of digital survey integrating different methods of data acquisition to obtain a database of the complete architectural structure on which to base the cognitive investigations.

Relevance for the session: The contribution deals with the digital relief methodologies focusing on the representation of the evolution of the building.

Innovation: The paper shows the first digital survey and the first three-dimensional reconstruction of the Church of St. George

References:

- Guarnieri, Alberto & Remondino, Fabio & Vettore A, A. (2012). Digital Photogrammetry and TIs Data Fusion Applied to Cultural Heritage 3D Modeling.
- Petre, James. 2010. Crusader castles of Cyprus: The fortifications of Cyprus under the Lusignans of 1191-1489. PhD Thesis, Cardiff University.

3D Documentation in Underwater Archaeology: Photogrammetry, Georeferencing, Monitoring, and Surveying

Chairs: Marco BLOCK-BERLITZ, Germany | Luca BEZZI, Italy

Archaeological underwater excavations are destructive and unrepeatable processes. The workflow of underwater site documentation is still complex and expensive. Diving operations, especially when photogrammetry is applied, need to be planned carefully. Sufficient, near-constant light conditions across several viewpoints and angles are required during image capture. Scientific drivers need special training and their diving times are strictly limited. Underwater georeferencing is another crucial challenge, because no GPS signal is directly available.

Beside the documentation of registered archaeological sites, the exploration of potential sites is a topic that attracts more and more attention. Unmanned Underwater Vehicles (UUVs,) can be used in both cases, careful and systematic excavation under water is still a domain of manual human Labor.

Focussing on key aspects of managing underwater surveys, this session invites papers dealing with topics such as:

- complete workflows and case-studies,
- decision/planning support processes for excavation campaigns,
- camera and lighting solutions for underwater archaeology,
- monitoring: continuous excavation and site recording for conservation and long-term studies,
- and data management solutions for recorded data and long-term accessibility of 3D data.

Contributions and perspectives are welcome, and may include the topics listed above or further improve established practise and processes.

Marco BLOCK-BERLITZ | Benjamin GEHMLICH | Michael BOMMhardt | Niklaas GÖRSCH | Hilmar BOCHMANN | Alexander HAFERLAND | Ketill GUNNARSSON | Carmen LÖW | Cyril DWORSKY, Germany

Using Aerial Documentation for Underwater Georeferencing at UNESCO Pile Dwellings “See am Mondsee” in Austria

Keywords: 3D reconstruction, UUV, SFM, Mondsee

Abstract: Georeferencing underwater 3D models is an ongoing challenge. Localization technologies such as GPS cannot be used as it's short-frequency waves only travel a very short distance under water. A common workaround is to use GPS to determine the position at the water surface, in addition to measuring the distance to the water's bottom [1]. The Archaeonautic Group at the HTW Dresden and the Kuratorium Pfahlbauten are actively developing a semi-autonomous system for documenting the remains of the pile dwellings, which are located in shallow water in the lake. The pile dwellings are over 6000 years old, and are a UNESCO World Heritage Site [2]. For this purpose, it is necessary to document the site, “See am Mondsee” regularly. This results in numerous underwater 3D models that need to be georeferenced. In April 2018, an aerial survey of the terrain was used for the first time prior

to the dive campaign as the basis for planning and georeferencing (fig. 1). For this purpose, a georeferenced 2.5D terrain model from a flight with 849 individual images was produced on the first documentation day (using an image resolution of 4864x3648 pixels). The water surface is flat, with the underlying pile structures clearly visible, giving us the top-down coordinates of various underwater structures. Furthermore, a few measuring points can provide the missing depth coordinate. In parallel with the aerial survey, a total of 7 dives with the mini submarine “Manio” were completed over two days, resulting in a 3D underwater model of approx. 50x60 meters. Manio has a module for real-time 3D reconstruction and can perform semi-autonomous documentation [3]. The transfer of the coordinates from the georeferenced terrain model results in a measured underwater model. The results are promising and can be a fast and accurate alternative to comparable documentation situations. Furthermore, best-practice solutions and processes for successful underwater documentation with UUVs will be presented.

Michaela REINFELD | Bernhard FRITSCH, Germany

On land, under water and in the air - new research at the villa maritima at the Cape of Sorrento, Italy.

Keywords: villa maritima, structure from motion, open access, data publishing

Abstract: The appearance and the magnificent design of Roman sea villas, the *villae maritimae*, is at least partly known to us on the basis of the Roman wall painting. However, whether the detailed paintings represent a reflection of reality or are attributable solely to the imagination of the artist, is not clear beyond doubt. Underwater archaeological research on the Roman villa on the Cape of Sorrento resulted in clear evidence of a luxuriously designed villa with two representative harbors, which served both the supply of the villa and the reception of high dignitaries. For the first time, the villa was documented photographically by a drone and a three-dimensional model of the complex was created. Using structure from motion, the two harbor complexes of the villa were also documented and considered in the interpretation for the first time. The resulting three-dimensional model of the entire complex provides information about the architectural design of the villa as well as the effort that was spent on the construction. The data allow a clear interpretation of the two harbor basins. However, some challenges had to be overcome in linking the 3d data generated in the air, on land and under water.

All data generated during the excavation campaigns (maps, 3D models, etc.) are available in an online repository at Edition Topoi (www.edition-topoi.org) according to the principles of open access. Thus, the research data on the villa are published, secured in the long term and citable. In addition, the open structure of the repository allows other researchers to freely use the data and metadata. Furthermore, the data can be easily integrated into other software packages for further analysis via an interface.

Relevance for the conference: The case study describes the documentation and presentation of a cultural heritage that is only visible to a limited group of people because of its difficult accessibility.

Relevance for the session: The paper describes a complete workflow, from the archaeological documentation above and under water, to the interpretation of the data, its digital publication and long-term backup.

Innovation: Based on the Villa on the Cape of Sorrento, the first attempt was made to create an overall model of a Roman villa, which includes both the terrestrial and underwater structures.

References:

- W. Filser – B. Fritsch – W. Kennedy – C. Klose – R. Perella, Surrounded by the sea: re-investigating the villa maritima del Capo di Sorrento. Interim report, Journal of Roman Archaeology 30, 2017, 64-95.
- Lafon, X., Villa Maritima. Recherches sur les villas littorales de l'Italie romaine, École française de Rome (Rome 2001).

Helena SEIDL DA FONSECA | Julia KLAMMER, Austria

(C)old case (pro)files - A GIS-based 3D evaluation method for documentation of past and modern data

Keywords: GIS, documentation, 3D visualisation/modelling, underwater archaeology, cultural heritage

Abstract: The existence of many archaeological sites are widely known among researchers, but they haven't yet been excavated or even mapped. When they are investigated as part of recent research, we always hope to uncover proper and accurate documentation from older initiatives. Until the last decade, this was mostly done in an analogue way, but nowadays we gather data predominantly by digitally recording it. So, if someone intends to research of a known site, they are usually faced with old, analogue records that have to be brought up to the basic level so as to conform to standards of modern documentation, and within a current working environment this means digital documentation. Site and profile drawings of archaeological features are generally very useful to record spatial context of archaeological structures. To match old drawings with newly acquired data, it is necessary to digitise and georeference them. But profiles in particular tend to be difficult in terms of reworking and positioning in the correct spatial position. In this lecture we want to present and discuss methods of how to facilitate this kind of data integration. We will share our experiences of dealing with two kinds of datasets that have to be merged and properly visualised so as to provide new insights into old projects.

Using the example of the underwater cultural heritage of prehistoric pile dwellings in Austria we show how data accumulations of analogue documentation can be included in a GIS-based 3D environment and incorporated with modern data.

Especially in these cases, profile drawings can reveal substantial archaeological information and can be seen as essential for 3D modelling of these sites. In addition, these data provide a basis for monitoring sites and for decision making processes (e.g. for the selection of future survey areas or the location of future underwater excavations).

Relevance for the conference: The GIS-based 3D evaluation of analogue documentation and new digital datasets show how archived data can be brought back to life, providing important insights into current projects dealing with historic cultural heritage sites.

Relevance for the session: The incorporation of analogue datasets into a GIS-based 3D environment is a topic a lot of archaeologists are confronted with and shows, when successfully performed, how former documentation can support preparatory work in Archaeology.

Innovation: Presenting new expert solutions to known issues when incorporating and integrating analogue data from older projects into modern GIS-based 3D environments.

References:

- <https://beyondlakevillages.wordpress.com>
- <https://www.pfahlbauten.at/projekte/zeitensprung>
- <http://hallstatt-forschung.blogspot.com/search?q=profile>

Helena SEIDL DA FONSECA | Henrik POHL | Ronny WEßLING, Austria

Back to the archaeology: benefits, challenges and limitations of computer vision for the interpretation process of excavated pile dwelling sites

Keywords: Underwater Archaeology, 3D documentation, Structure from Motion, prehistoric pile dwellings, excavation evaluation

Abstract: Since 2015 there have been four underwater excavations in pile dwelling sites in the lakes Attersee and Mondsee in Austria. The excavations are part of the national research project “Zeitensprung”, with the focus of gaining new data for a large exhibition about the UNESCO World Heritage “Pile dwellings around the Alps” in Upper Austria in 2027.

Therefore the sites were recorded using Structure from Motion (SfM) and Multi View Stereo (MVS) not only for documentation purposes, but also with the goal of an appealing visualisation of the excavation process for the public.

As all of the four sites were systematically recorded, using an image based modelling approach, the time has come for an evaluation of this technique. This paper is not limited to the presentation of the recording workflow or the final results, but is asking what the added value of SfM and MVS is.

Particularly for the archaeological analysis and interpretation of underwater excavations. Based on the case study of Weyregg II we will present our insights in handling SfM and MVS derived data during the post excavation process and will show the benefits and the challenges we had to overcome as well as the limitations you need to be aware of.

Relevance for the conference: The lecture deals with the evaluation of underwater SfM-documentation by sharing our experiences on settlement excavations and showing the benefits and the limits of this method.

Relevance for the session: Within the lecture we will present the practical use of SfM documentation during underwater excavations, also showing the value of this method in the archaeological reconditioning process.

Innovation: We will rise above the educational level of presenting the technical process of SfM documentation underwater and focus mainly on the practical application of this method on archaeological issues.

References:

- M. Callieri, N. Dell’Unto, M. Dellepiane, R. Scopigno, B. Soderberg, L. Larsson 2011, Documentation and Interpretation of an Archeological Excavation: an experience with Dense Stereo Reconstruction tools. In: The 12th International Symposium on Virtual Reality, Archaeology and Cultural Heritage VAST (2011)

- M. Dellepiane, F. Niccolucci, S. Pena Serna, H. Rushmeier, and L. Van Gool (Editors). - R. Weßling, J. Maurer, A. Krenn-Leeb, 2014, Structure from Motion for Systematic Single Surface Documentation of Archaeological Excavations. Proceedings of the 18th International Conference on Cultural Heritage and New Technologies 2013 (CHNT 18, 2013).

Immo TRINKS | Mario WALLNER | Klaus LÖCKER | Jutta LESKOVAR | Timothy TAYLOR | Wolfgang NEUBAUER, Austria

Efficient underwater archaeological prospection using high-resolution multibeam sonar and sub-bottom profiler measurements

Keywords: underwater prospection, multibeam-sonar, sub-bottom profiler, lake dwellings, UNESCO World heritage

Abstract: The Vienna based “Ludwig Boltzmann Institute for Archaeological Prospection and Virtual Archaeology”, in collaboration with the County of Upper Austria - Direktion Kultur, and the “Vienna Institute for Archaeological Sciences” of the University of Vienna, has in the past two years set up a unique high-technological research infrastructure for large-area high-resolution underwater prospection in shallow waters, extending the large-area archaeological prospection approach from land to shallow underwater sites. This infrastructure consists of a seaworthy cabin motorboat as survey platform with computer workstation, an ultra-high-resolution multibeam-sonar system including state-of-the-art software and sound velocity profilers, an innovative four-channel parametric sediment-sonar for sub-bottom profiling in very shallow water, as well as the necessary precise data positioning system. As first case studies, the UNESCO World Heritage pile dwelling sites in the Upper Austrian lakes Mondsee and Attersee will be explored, mapped and documented using this novel prospection system in the framework of the "ArchPro Oberösterreichische Pfahlbauten" project (www.archpro.info). We will present technology, methodology and first results of the large-area application of this innovative underwater archaeological prospection approach.

Relevance for the conference: We present the visualisation of Austrian underwater cultural heritage through massive bleeding-edge digitalisation of the bathymetry of Upper Austrian lakes and lake sediments.

Relevance for the session: What could possibly be more relevant, aside of underwater image based modelling - at much smaller scale?

Innovation: You ain't seen nothing like that before

References:

- Check the www.tiefenschaerfe-bodensee.info project on something comparable, but at lower resolution.

Visual Experience of the Past

Chairs: Willem BEEB | Benno RIDDERHOF, The Netherlands | Giorgio VERDIANI, Italy

In recent years the way of visiting museums, archaeological sites, and historical places has changed. The often heralded “integration” of digital media and the physical world has become more and more part of these Cultural Experiences. Even a place with an enormous artistic and historical value, cannot exclude itself from the need of finding a solution for the smooth integration of digital information (VR/AR) with the traditional methods of presenting CH. This is due to the abundance of smart and personal devices, enabling everyone to retrieve information whenever data access is possible.

At the same time, this is a way “to push the distant past into the present” explaining complex concepts with fascinating technology. The use of the right tools can bring the understanding of CH a major step forward, but the optimal use of these new techniques is still an ongoing process. The quality of the content is a matter of concern, as are practical and sustainable solutions. It is very necessary to share experiences, and to define common characteristics and best practices.

At the same time, the search for these new visions should not rule out previous solutions, which can be seen as potential references and/or basis for new developments. In this way combining new and old techniques to augment the perception of CH can be one of the pathways to Innovation.

In this session, a fast presentation will be used based on 6 slides in 6 minutes. This allows all interested scholars to quickly share their views on “Visual Experiences”. The intention is to discuss a new perception of CH for the general public, describing subjects, challenges, solutions and lessons learned. A major part of the session is reserved for an extended exchange of ideas and experiences with all the participants and the audience.

Andrea ASCHAUER | Jürgen HAGLER | Jeremiah DIEPHUIS | Michael LANKES, Austria

The Virtual House of Medusa: Playfully Collaborative Virtual Archaeology in a Museum Context

Keywords: VR Museum Installation, Virtual Archaeology, Shared VR, Co-located Play

Abstract: Virtual and Augmented Reality (VR & AR) technologies are becoming increasingly important in educational and cultural contexts, providing users an interactive experience with cultural and historical content. Particularly for material and structures that are no longer in existence or are too fragile to be available to the general public, such approaches permit a level of access that would not be possible otherwise.

However, despite the growing success and promise of VR and AR technologies in this field, current applications primarily focus on an immersive single-user experience and typically do not employ collaborative elements that can promote discussion, reflection and other social aspects. In addition, very little has been done to integrate larger audiences into such activities, which would enable multiple participants and audience members who occupy the same physical space to interact and create a shared cultural experience.

The Virtual House of Medusa (VHM) is an interactive co-located playful VR installation for a museum context that was developed in collaboration with the Federal Monuments Authority Austria to illustrate several fragments of Roman wall paintings. The installation employs a cooperative approach that allows participants to slip into the role of archaeologist and restorer and interact with digitized

artefacts. Four virtual workstations provide different perspectives and playful interaction possibilities to actively engage multiple users in their exploration of the remains of an historic Roman villa. The VHM has been undergoing evaluation in multiple museum contexts and preliminary analysis from these activities indicate potential benefits and ongoing challenges for interactive museum installations.

Relevance for the conference: The VHM features an innovative, tested approach to involve multiple participants in an interactive VR museum installation featuring cultural heritage content.

Relevance for the session: The VHM has been exhibited on several occasions (Kunsthistorisches Museum, Ars Electronica Center, et al) and has resulted in a number of lessons learned that are relevant for other museum installations.

Innovation: The VHM effectively deals with the challenge of visualizing overlapping repainted fresco levels from different time periods and actively engaging multiple participants in a museum context.

References:

- Ishii, A., Tsuruta, M., Suzuki, I., Nakamae, N., Minagawa, T., Suzuki, J., Ochiai, Y.: ReverseCAVE: providing reverse perspectives for sharing VR experience. In ACM SIGGRAPH 2017 Posters (SIGGRAPH '17). ACM, New York, NY, USA, Article 28, 2 pages (2017).
- Sierra, A., de Prado, G., Ruiz Soler, I., Codina, F.: Virtual reality and archaeological reconstruction: be there, back then. MW2017: Museums and the Web 2017. <https://mw17.mwconf.org/paper/virtual-reality-and-archaeological-reconstruction-be-there-be-back-then-ullastret3d-and-vr-experience-in-htc-vive-and-immersive-room/>, last accessed 2018/02/18.

Frederick BAKER, UK

Klimt's Magic Garden

Keywords: Interactive VR Experience Museum Klimt

Abstract: Klimt's Magic Garden is a VR experience created vor HTC vive that shows and then transforms the Stoclet frieze by Gustav Klimt into an interactive walk around experience - a magic garden. it is the first use of Interactive VR in a large public museum and has been highly successful with the public, having its display time extended from 2 to 8 months at the MAK - Museum of Applied Arts in Vienna. The world that the public can explore is made up of 100% colors and images taken from Klimt's work, that tell a story expectation and fulfillment. Traveling from expectation the fulfillment the user can climb hills dive into lakes and cross intricate bridges in a landscape based on the Attersee region of Austria that gave Klimt the idea for many of his works. As an Archaeologist and filmmaker I argue that though only 100 years old the methodology used to create this experience is relevant to the presentation of friezes and cultural heritage that is much older. Secondly the paper will present the results of detailed market research into the use of the installation by the publican the museum. This is important because, it is argued that there is much to learn from this pioneering work into how to make VR work in museums. Finally it will be argued that this work shows that a key factor to the success of VR is the proximity to the analogue originals that inspired it. Klimt's Magic Garden is shown in the very same gallery as Klimt's original - analogue aura meets digital aura

Relevance for the conference: A successful case of making Cultural Heritage attractive to a broad public using VR

Relevance for the session: Using the the power of new visual methods to refresh the eyes of the public for old visual artifacts

Innovation: Interaction and story telling in a fully surround environment

References:

- Frederick Baker "Digital Difference...." in CHNT 19, Frederick Baker Art of Projectionism. 2007

Cristiana BARANDONI, USA

Mann-In-Colours. The first Italian database on polychromy of ancient sculptures

Keywords: 3D models, photogrammetry, virtual experiences

Abstract: Mann-In-Colours is a three year scientific project carried out by the National Archaeological Museum of Naples in collaboration with the National Taiwan Normal University di Taipei. The project examines chromatic traces, sometimes imperceptible to the human eye but still existing on sculptures and will aim at a visual recovery that will revolutionize the aesthetic perception to which these works have accustomed people for Centuries. From the scientific point of view the project includes conducting chemical and physical surveys on selected sculptures belonging to the Farnese Collection (all the investigated object will also be transformed into 3D models using photogrammetry); the analyses will allow to recompose pertinent chromatic sets. All collected data will be systematized in a database shaped for this purpose, usable by scholars; a specific selection of data will instead be offered to general public fruition. This is first database on ancient polychromy of an Italian national museum.

Beside the database this project aims to build a physical and virtual community that can experiment new forms of communication visiting this Museum, all based on scientific approach. This branch of the project is intended to stimulate inclusion, empathy and engagement while improving knowledge of specific archaeological artefacts, thanks to the use of digital media, never employed to enhance this field of study before. Once a year, all the data collected on the database will be directed toward the realization of a virtual exhibition.

Beyond its scientific value, the project aims at stimulating visitor's emotional involvement: to do so an Expert Room will allow public to closely observe activities of the scholars engaged in the research. Lots of contents will be available also via web thanks videocasts and podcasts uploaded on the Museum website.

Relevance for the conference: Introduction to the potential of digital to enhance visualization of archaeological context and collections

Relevance for the session: It is stricly related to visual experiences

Innovation: employment of new technologies never used before in this field

Monica BERCIGLI, Italy

Masada, the desert fortress. Discovering the archaeological site by gaming.

Keywords: Archaeology, Serious Game, Gaming, 3D reconstructions, Storytelling

Abstract: In the last decades the interest in the use of serious games as a learning tool has grown and the awareness of how the game is effective in the transfer of information from the object to the user, is consolidated.

The paper discusses the possibilities that this type of tool offers in terms of learning and dissemination of cultural heritage. Through the consolidated methodologies of survey and representation, the key points are highlighted for the realization of an interactive 3D model that can be used through "playable" modalities.

The interaction between the information contents and the visualization tools required a reflection on the quality of the graphic system and the virtual design. Everything must be designed to be an expression of an effective graphic language, starting from the narrative plot up to the rules of the game and the scenario. Special attention is given to the creation of the graphic interface, the buttons, the layout and the color palette.

A possible game platform designed about the Masada fortress in Israel is still developing and, as well as representing an instrument for sharing Cultural Heritage, supports the conservation of artifacts; at the same time it allows to know and protect the intangible assets that make up the identity of the places represented.

Relevance for the conference: New tools to promote the knowledge about the archaeological site

Relevance for the session: New tools to promote the knowledge about the archaeological site

Innovation: New approach using serious game as tool of visualization and dissemination of Cultural Heritage

References:

- Michael D., & Chen S. (2006) *Serious Games: Games that Educate, Train and Inform*. Thomson Course Technology PTR, Boston
- Mortara M., & AI (2014) Learning cultural heritage by serious games. In: *Journal of Cultural Heritage*. Elsevier, vol.15(3)

Marco CALLIERI | Rachele MANGANELLI DEL FÀ | Andrea ARRIGHETTI | Giovanni MINUTOLI | Giovanni PANCANI, Italy

Different paradigms for different spaces: showing the Montagnola Tomb inside & out.

Keywords: web viewer, immersive 3D, maquettes, presentatin to public

Abstract: The "Montagnola Tomb" is an Aetruscan burial mound in Sesto Fiorentino. Excavated in 1959, has never been properly opened to the public. Given the difficulty of having a full-time opening, the institutions wanted a "virtual" presentation of the hypogeum, to integrate the future visits.

But which was the correct way to present such a monument?

As most buildings, this tomb, too, spans across two different spaces: an outer space and an inner space. The mound is made to be seen from outside, as a monumental statement of power, and inside, as a private place of contact with the departed. Wanting to give to the visitor a complete perception of

the monument, we had to work on both of these aspects, choosing for each side the correct presentation paradigm.

For the outer space, the user should appreciate the shape, size and proportions of the structure, and understand the relationship between visible and invisible areas.

Maquettes have been always used in museums, to present environments and reconstructions of ancient spaces. Their language is cross-cultural and accessible.

By combining the language of maquettes with digital technologies, it was possible to setup an interactive presentation of the tomb structure using predefined views, cut-through sections, and transparency effects.

Conversely, for the inner space, the user has to experience a sense of presence inside the mound. The paradigms of Virtual reality and immersive 3D are the perfect tools to let the viewer roam inside the tomb, and experience the inner space with an assisted navigation.

We chose the web3D platform, as it ensured a wider audience, and the 3DHOP tool to implement the two viewers.

We are now moving “outwards”, extending the two presentation paradigms: using 3D printing to create physical maquettes, while, on the other side, porting the 3D virtual visit on immersive VR devices.

Relevance for the conference: This work is focused on the design of methodologies for the effective data presentation to the public through advanced technologies

Relevance for the session: The paper deal exactly with the issue of presentation paradigms, going from the physical to the immersive VR

Innovation: We show how, with a careful design, it is possible to create two specialized viewers with significantly diverse presentation paradigms, starting from the same base data and tools, and then expanding the concept to physical reproduction and VR

References:

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Alessia D'ANGELO | Luca GUGLIERMETTI | Oliviero ELETTI | Barbara De LIETO | Franco GUGLIERMETTI | Luciano RICCIARDI, Italy

Crowdsourcing and photogrammetry as alternative tool to visualize cultural heritage

Keywords: Cultural heritage, crowdsourcing, photogrammetry, 3D model, visualization

Abstract: In recent years new ways to visualize cultural heritage has born; the use of ICT permits to enrich the contents of museums, archeological sites and historical places with 3D reconstructions, virtual tours and AR/VR contents. However, today only few cultural assets have an accurate 3D model with an informative layer. The costs related to the creation of virtual content are high and they are addressed only for the most iconic or important monuments of a site. In this work the use of crowdsourcing (as employees or interested tourists) as manpower to create 3D models is discussed. Photos taken by users can be elaborated automatically with photogrammetric techniques to create

models almost at no-costs. The main alternative to photogrammetric technique is the standard relief and laser scan, both methods are costly and necessitate of specialized personnel. Moreover, using photos taken at different time is possible to visualize any change in shape or color potentially connected to degradation or damages. With the help of site's staff also many difficult to access or no-access area can be reconstructed to be showed to the public, increasing the offering of archaeological sites or to show the artworks stored in warehouses. To validate the results a chromatic and dimensional evaluation study were made, to ensure compliance with the accuracy and reliability necessary for a good fruition. At least, it was studied the possibility to implement directly the 3D models in a virtual reality environment to increase the diffusion, usability and immersion as well as allowing the addition of multimedia and interactive contents. The site analyzed were the archeological park of the Colosseum and ancient harbor of Ostia in Rome.

Relevance for the conference: The research proposes an innovative and almost costless approach to improve cultural assets visualization by the employ of crowdsources, the 3D model obtained can be used to make a track-change or to create a VR environment.

Relevance for the session: The idea is to create a new Visual Experience of the Past, the 3D model, obtained by crowdsourcing, can be used to make a track-change study or to create a VR environment.

Innovation: Using photogrammetry and crowdsourcing is possible to produce, almost at no-cost and in real time, 3D models sufficiently accurate to be used not only for the enhancement, reconstruction and monitoring in cultural heritage, but also for BIM design and environmental issues.

References:

- S. Al-kheder, Y. Al-shawabkeh, N. Haala, "Developing a documentation system for desert palaces in Jordan using 3D laser scanning and digital photogrammetry", Journal of Archaeological Science, 2009, Volume 36, pp. 537-546.
- G. Bitelli et al., "From the photographic survey to virtual reality movies and web integration for the study of an archeological site," in Proc. 2nd Int. Cong. on Science and Technology for the Safeguard of cultural Heritage in Mediterranean Basin, Paris, France, 2000, pp. 149-151.

Zdravko DIMITROV | Miglena RAYKOVSKA | Emil MICHOV, Bulgaria

Virtual reality for rescue excavations: preserve the non-preservable. The example of the Roman villa rustica near Blagoevgrad.

Keywords: Rescue excavations, roman villas, virtual reality

Abstract: Over the last two years 2017-2018 near to Blagoevgrad has been excavated the largest archaeological site in Bulgaria. This is a large Roman villa (an area of over 30 decars), with production centers for ceramics, metal and other materials, its family tomb and part of the nearby village. The chronology is I-VI c. AD. There we found also the roman military diploma from the year 74 AD. The villa is located on the route of the new highway from Bulgaria to Greece. That is why it is imperative to include all new technologies for digital documentation and repairs in these rescue excavations. In order to save these archaeological structures, which will soon be lost on the field, our large team carried out a complete photogrammetry of architectural complexes from the site, aerial photography, orthophotography and graphic reconstructions, a complete virtual tour of the separate premises of the

villa and the tombs. The main idea of the scientists, excavating the villa, is to create a new museum (in situ), along the highway, on that part of the site that will be preserved. This museum, which will expose the tombs and large parts of the villa, will provide virtual tours of the complex, exposed finds, graphic reconstructions, and most of all 3D visualisation of the villa complex.

Relevance for the conference: The conference allows us to present this new object in the best way to preserve it

Relevance for the session: The virtual reality is the only way to keep Roman villa data in the way it is discovered

Innovation: In the case of the Roman villa for the first time in Bulgaria, all these virtual reconstructions are carried out

Doris EBENSCHWANGER | Daniel ISEMANN | Sander MÜNSTER, Germany

Perception of Historical Buildings in Virtual Reality and Good Old Fashioned Reality - A Comparative Study

Keywords: visual perception, VR, user study

Abstract: Recent improvements in the development of virtual reality technologies, allow for digital reconstructions to be explored in a more realistic and user friendly virtual environment. By comparing the perception of virtually reconstructed historical buildings via Head-Mounted Displays (HMDs) with the perception of the actual buildings one can highlight salient differences and integrate this knowledge into future work. In our study we compared and analyzed the perception of historical buildings in virtual reality with the local perception of the actual buildings. Our main goal was the development of a detailed overview of the most differentiated perceptual aspects. To achieve this, we conducted a comparative study about the virtual and actual perception of three historical buildings – a church, an historical tower and a 19th century villa – from Schwandorf (Bavaria). The first part examined the perceptual aspects of those buildings in Schwandorf locally. 16 persons were asked to fill out a questionnaire about the estimated height and age of the buildings and their aesthetic impressions. For the second part the same three buildings from Schwandorf were digitally reconstructed with Blender and texturized via the Quixel material library. Using an HTC Vive, 15 people took part in the virtual reality study and filled out a digital questionnaire. In the end, answers from both parts were compared. It turned out that the estimation of height and age of digital reconstructed buildings seemed to differ while the assignment of adjectives were rather similar during both studies. By comparing both questionnaires about the perception of the three buildings in virtual reality and locally, it showed that the composition of the virtual environment affected the perception of digital reconstructed buildings via Head-Mounted Display much stronger than their textual appearance. However, the height of every building was overestimated by the majority of both evaluations.

Eleonora GANDOLFI | Graeme EARL | Grant COX, UK

Digital Open Scholarships in Heritage: how archaeological data can be reused to engage digital audiences

Keywords: cloud tour; MOOCs; public engagement; Portus; data reuse

Abstract: This paper present and discuss the development of a Web Portal to access data from heritage sites.

Digital data from photogrammetry, 3D modelling, laser scanning, photography, open access publication and MOOCs have been linked by the Web Portal created for the roman site of Portus in Italy (<https://www.cloudtour.tv/portus>) to create a different visual and easy accessible narrative and to explore its potential role for open education (or to support compulsory education) and public engagement. The tool functionality was developed to meet the needs of archaeologists, local authorities and end users, including school kids that have used the tool to integrate their traditional school curriculum. It can be accessed both on PC or on mobile to facilitate the link between digital and physical while on site, keeping the re-use of digital outcomes created by the archaeological project at the heart of the process.

This paper will report on the different stages of development of the tool and the methodology used to link the data available, the difficulties encountered and strengths of the approach. It will also describe the results of the testing and formal evaluation on how effective the tool is in engaging with learners, including students in compulsory age education, and impact on awareness of Roman Cultural Heritage worldwide.

Relevance for the conference: The research focuses on different digital visual contents (VR, video and 3d reconstruction) produced by the Portus project and how they could be re-used for different porpuses.

Relevance for the session: The tool that will be presented has helped to engage different audiences digitally (including schools kids) and while on the site by collecting already available resources and creating a new narrative that support the development of transferrable skills.

Innovation: The Cloud tour developed is unique and has developed a new way to access, explore and re-use digital visual content (video, 3d Models, photogrammetry/laser scanning)

References:

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Arie KAI-BROWNE | Thomas BREMER | Kay KOHLMAYER | Julia GONNELLA | Sebastian PLESCH | Susanne BRANDHORST | Jona SCHLEGEL, Germany

Spatial Contextualization of Cultural Heritage – the Cupola of the Torres de las Damas on the Alhambra

Keywords: Virtual and Augmented Reality, Alhambra, Image-based Modelling, 3D-Scan

Abstract: The technological advance in the field of image-based modelling as well as 3D-scanning offers a variety of promising applications to enhance our understanding of cultural heritage. Based on highly accurate and detailed 3D-models of cultural monuments, both the public as well as fellow researchers do not only have the possibility to visually explore cultural heritage independent of their

location but are even able to interact with various data sets using immersive technology such as Virtual and Augmented Reality. The major advantage for institutions dealing with knowledge transfer, such as museums, is that individual objects, that were removed from their spatial context, can be virtually placed within their original setting, thus enabling the visitor a more comprehensive insight of the objects background. Furthermore, interactive real-time environments can be enriched with additional content such as textual information or scientific reconstructions, such as past landscapes . A team of researchers of the DE:HIVE Institute at the University of Applied Sciences Berlin, has been using 3D technology for the spatial contextualization of cultural monuments and applying various methods for an immersive interaction with complex 3D-data. In the current case study, the cupola of the Torres de las Damas of the Palacio del Partal on the Alhambra, which was brought to the Museum for Islamic Arts Berlin in the beginning of the 20th century, has been documented using a 3D data-fused based approach. In addition, the tower room, where the cupola originated from, was recorded as well with the same methodology resulting in a 3D-model with sub-millimetric resolution. Through the use of VR as well as AR technology these highly accurate and detailed data sets enable laymen as well as researches to interactively experience the contextualized architecture for the first time since their original separation.

Relevance for the conference: The paper showcases the advantages when using 3D technology for the spatial contextualization of cultural monuments and discusses the challenges when applying various methods for an immersive interaction with complex 3D-data.

Relevance for the session: The paper discusses the benefits for museums of virtually contextualizing individual objects, which have been removed from their original surrounding, to enable visitors a more comprehensive insight of the objects background.

Innovation: The innovative character of this papers is the emphasis on utilizing extremely high resolution data for capturing architecture and combining the models within an interactive 3D-environment, enabling a truly immersive experience for the viewer.

References:

- Thomopoulos S.C.A. et al. (2016) DICE: Digital Immersive Cultural Environment. In: Ioannides M. et al. (eds) Digital Heritage. Progress in Cultural Heritage: Documentation, Preservation, and Protection. EuroMed 2016. Lecture Notes in Computer Science, vol 10058. Springer, Cham.
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Marleen DE KRAMER | Christopher MORSE | Sam MERSCH, Luxembourg

What's In A Name: Gamifying the Intangible History of Larochette, Luxembourg

Keywords: Intangible Cultural Heritage, Luxembourg, Gamification, Place Names

Abstract: Much as people learn to read a book, they must learn to read a landscape — its individual elements, its hidden connections, its historical context. Our project aims to make historic cultural landscapes — notably their structure, land use, relation of town and countryside, and key buildings —

accessible to the public, while also showing the many types of data that can help inform our knowledge.

Gamification is a powerful tool for garnering interest in a subject previously perceived as boring. Our project harnesses this effect, presenting the results of our preceding landscape study in an interactive educational environment that rewards the user for engaging with the content.

In our app, users will be able to look out over the landscape surrounding Larochette, Luxembourg from atop a virtual reconstruction of its castle. Correctly answering questions about the meanings of the names of fields and other landscape elements slowly populates it with depictions of the historic landscape, revealing its intangible heritage in a visual, easily understandable way.

To our primary target user group of children and adolescents, the interface will be intuitive, and progress will be easy to measure; learning how place names connect to history is implicit, but not presented as the major goal. The app is designed to elicit positive experiences, notably inspiring interest (as described by Silvia, P., 2008), as a way to immerse young learners within a small piece of Luxembourg's past and preserve and disseminate its intangible heritage (continuing the work of i-Treasures, Alivizatou-Barakou et. al., 2017) in particular, a key goal of UNESCO's Convention for the Safeguarding of Intangible Heritage. The app therefore is a collaborative case study in digital history and the experience of it, one that is grounded within user experience design and informed by the historical and architectural expertise of the collaborators.

Relevance for the conference: We visualise a landscape reconstruction, focusing on making its intangible heritage in the form of microtoponyms visible to an average user.

Relevance for the session: We describe an app that overlays the historic cultural landscape over views of the present day.

Innovation: The app serves to pique the interest of children in a traditionally very dry subject, linguistics.

References:

- Silvia, P. J. (2008). Interest—The Curious Emotion. *Current Directions in Psychological Science*, 17(1), 57–60.
- Alivizatou-Barakou et. al. (2017). Intangible Cultural Heritage and New Technologies: Challenges and Opportunities for Cultural Preservation and Development. *Mixed Reality and Gamification for Cultural Heritage*, 129-158.

Christoph LOBINGER, Germany

The international project VirtualArch: visualization and presentation of hidden archaeological heritage across Cenral Europe

Keywords: visualization and presentation of hidden archaeological heritage; international cooperating approach

Abstract: Different approaches and challenges, sharing experiences but reaching the same goal – a better understanding and raised awareness of hidden archaeological heritage and its protection by presenting it via new information and communication technologies like VR/AR. That's the main background of the new EU-project "VirtualArch – Visualize to Valorize", running from July 2017 to June 2020. 10 partners from 8 central European countries try to elaborate a transnational strategy.

Therefore, 8 selected pilot sites were digitized/visualized and present to stakeholders through guided field tours and information points on spot. The pilot sites are consisting of special heritage sites like prehistoric and medieval mines, roman and medieval harbors as well as cultural landscapes with prehistoric pile dwellings or urban archaeology with huge and complex stratigraphies. This means not only different arch. cultures but also different areas and environments, impacts and audiences. Although the project is still in the beginning, the session seems to be a perfect area to present project and its actors as well as share first experiences with all present professionals and experts.

Relevance for the conference: This new project unites several big players in 3D recording and virtual reconstruction in visualizing and presenting hidden archaeological sites across Central Europe.

Relevance for the session: With different pilot sites in cultures, types and environments the project may be regarded as a best practice of the session topic itself: Multiple ways to visualize Cultural Heritage for the General Public!

Innovation: The strength and importance lies in the transnational cooperation and its heritage protection goal which is focused not only on one heritage type.

References:

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Adele MAGNELLI | Stefania BANDINI | Matteo VENTRELLA, Italy)

Casanova Museum and Experience: how to integrate History with Virtual Reality in order to relive the past.

Keywords: Virtual Reality; Immersive Experience; edutainment; history

Abstract: Giacomo Girolamo Casanova (Venice, 2 April 1725 – Duchcov, 4 June 1798) was an eclectic and complex character: he was an adventurer, writer, poet, alchemist, diplomat, philosopher and spy. Above all, he was a great connoisseur of the feminine soul.

In part of a typical Venetian Gothic building, Palazzo Pesaro Papafava, the “Casanova Museum & Experience” is the first museum in the world dedicated to the most famous Venetian of them all.

Commissioned by Casanova srl and the Casanova Foundation, it was created, organised and fitted out by ETT SpA, to propose a new look at the perception and history of Casanova the man.

This museum expands on the conventionally held view of the “experience exhibition”, or of a “virtual museum”, with an innovative multimedia setup. It is a new concept of “immersive museum”, with the exhibition layout mixing semi-transparent overlaid sheets, panels with graphics and projections, and curved and straight video walls. Original high-resolution images, essential graphic design and chromatic harmony accompany visitors and introduce them to eighteenth-century Venice, offering an incredible and completely immersive experience.

Eighteen Samsung GearVR S7 viewers give visitors the opportunity “to be” Casanova, with a 360-degree subjective-view video. Specific “mixed-experience” solutions and the various sets of hybrid display settings provide moments of shared views and enjoyment. Each multimedia unit gives “didactic

- information” content in a distinctive way and at differing levels: videos, pictures and a collection of data and historical information are included. The audio-guides are in ten languages, giving visitors from all over the world a chance to discover the true life of Casanova.

Meeting today’s visitor expectations, delivering excellent cultural content with varying and personalised techniques, by offering practical ways to enhance, but not replace, traditional cultural institutions. This is the Casanova Museum project goal.

Relevance for the conference: The use of new technologies in a museum setting makes possible to tell historical events in an engaging way

Relevance for the session: The re-enactment of the past is successfully carried out combining Virtual Reality with the traditional elements of an exhibition

Innovation: Casanova Museum and Experience exploits interactive exhibits, immersive surroundings and a compelling multimedia storytelling in order to create a valuable experience for each visitor.

References:

- <https://www.youtube.com/watch?v=ilxCdSVwE4o>
- <https://www.youtube.com/watch?v=UHc8-legmII>

Matthew NICHOLLS, UK

Virtual Rome: large-scale public responses to digital 3D cultural heritage in a MOOC.

Keywords: 3D, MOOC, public, heritage, ancient history, digital visualisation.

Abstract: Dr Matthew Nicholls has created a large-scale digital model of ancient Rome. The talk proposed here draws in particular on the most recent deployment of the digital modelling project in a five-week Massive Open Online Course (MOOC) launched on the FutureLearn platform in 2017, freely available to any learner. Cohorts progress through together, discussing their learning online as they go. The particular innovation that this paper will discuss is the embedding into the course of a series of ‘live’ digital models of ancient Roman buildings. This was done using the free service Kubity, which allows the user to rotate, scale and explore models on a computer desktop or via a free mobile/tablet app (example here). This was the first time 3D content of this type had been built into a FutureLearn MOOC and delivered at scale to a large cohort. The pedagogical idea behind this was that active exploration of a 3D environment is more compelling than viewing 2D static or moving reconstructed images. The first three runs of this course attracted 27,000 learners from around the world, creating a corpus of over 50,000 comments, many of which discuss responses to 3D reconstruction of ancient sites and to the process of engaging actively with 3D reconstruction. Initial sorting and ordering of this database of comments has been undertaken, with key findings starting to emerge. For example, we see a high level of enthusiasm for exploring models; a strong desire for the inclusion of sound; a range of responses to the user interface and to the learning gain of using such technology to think about ancient sites. The extent of this database of learner feedback constitutes an unusually large mass survey of public responses to digital reconstruction, and a summary of this feedback will be the core of this paper.

Relevance for the conference: It discusses mass feedback from tens of thousands of members of the public to detailed digital reconstructions of ancient Rome.

Relevance for the session: It addresses the panel's concern to find common ground and practical solutions for presenting 3D cultural heritage to a public audience.

Innovation: The embedding of live user-manipulable 3D content into a mass public-facing free online course

References:

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Eva PIETRONI | Alfonsina PAGANO | Enzo D'ANNIBALE, Italy

The use of holographic showcases inside the museum's context. Towards an advanced museology creating a dramaturgy around the exhibited objets.

Keywords: holographic showcase for museums, Pepper's Ghost techniques, perception and storytelling, mixed reality, user experience

Abstract: The basic idea of a hologram is an apparition of something that doesn't exist but appear as if it was just in front of our eyes. Indeed these illusion technique were invented a long time ago, the innovation nowadays consists in the adopted technology to produce them.

From the XVI century there were many experimentations that were brought in the theatre, fascinating the spectators. The philosopher and alchemist Giovanni Battista della Porta invented an effect that was later developed and made very famous by Professor John Henry Pepper (1821-1900).

Today there are different types of holographic techniques, some of them are not properly holograms but they are very good in terms of visual quality. The ancient Ghost technique is still used on the stage of concerts, at large scale, or inside a museum's showcase, at smaller scale.

Taking advantage of the available digital technologies, the challenge today is to realize a new form of scenography and dramaturgy around the museum's objects, with a robust and easy technology, compatible with preservation needs.

Since the the holographic effect is an illusion of reality, there are specific rules and constraints regarding perception and editing that must be respected and that will be discussed, while some choices in the design depends also on the environmental conditions.

Pure visualization, without additional contents, can be useful for digital collections. However if we want to transmit historical contents, the script and the sound play a fundamental role, combined with a dynamic lighting system inside the showcase. We can create a virtual dramaturgy around the real object.

The reconstruction of senses and of symbolic dimensions that are "beyond" the object can take the visitor in the middle of a lively and powerful experience. Case studies will be presented, in the framework of the EU project CEMEC.

Relevance for the conference: For years museums worked confining multimedia contents on limited projection screens or surfaces. Digital contents have been juxtaposed with real artifacts but never really integrated and combined together to produce something new and more powerful, as a mixed reality. The intent of creating a real drama inside the museum space to push the user's sensory involvement within a story, has brought to test innovative representation techniques that communicate

with the exposed objects, such as holograms, Pepper Ghost's effects living inside the showcase and interacting with the real artifacts.

Relevance for the session: The reasons of the adopted design in the holographic showcases realized in the museums of the EU CEMEC network will be presented, and communicative solutions, the technical realization, and some more meaningful data from the user experience evaluation, useful to extract some general guidelines about the methodological approach in the use of holographic techniques inside museums and novel approach in storytelling.

Innovation: Novel frontier in storytelling inside museums, integration between real and virtual contents, studies in sensorial perception carried on the public of different museums/cultures in Europe experiencing holographic showcases

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- Eva Pietroni, Enzo d'Annibale, Daniele Ferdani, Massimiliano Forlani, Alfonsina Pagano, Leonardo Rescic, Claudio Rufa: BEYOND THE MUSEUM'S OBJECT. ENVISIONING STORIES, In EDULEARN17 Proceedings 9th International Conference on Education and New Learning Technologies July 3rd-5th, 2017 — Barcelona, Spain Edited by L. Gómez Chova, A. López Martínez, I. Candel Torres IATED Academy ISBN: 978-84-697-3777-4 ISSN: 2340-1117 Depósito Legal: V-1538-2017

Veronika POLLOCZEK | Mihailo POPOVIC, Austria

The Digital Tabula Imperii Byzantini (Dig-TIB) as Contribution to the World's Cultural Heritage

Keywords: Byzantine Studies; Historical Geography; Digitising; Long Term Data Archiving; Cultural Heritage

Abstract: The devastating impact of wars on the World's Cultural Heritage has been discussed thoroughly after 1945. Scholarly projects at the Austrian Academy of Sciences have a long tradition of contributing significantly to the field of Cultural Heritage. Amongst them is the project Tabula Imperii Byzantini (TIB), which is dedicated to the the creation of a historical atlas of the Byzantine Empire with a special focus on the Balkan peninsula and Asia Minor. During surveys in both regions since 1966 monuments and their (then) current state were documented by means of photography (for decades through slides).

This unique collection of Byzantine monuments (52,000 slides) is a rich cultural asset and a hub for future scholarship.

The aim of Dig-TIB, which is funded by the Jubiläumsfonds der Österreichischen Nationalbank (Project No. 17771), is not to confine itself to digitisation / preservation alone, but to address three distinct case studies of the TIB in order to embed the respective monuments and their destinies throughout the past decades into the overall World's Cultural Heritage.

Dig-TIB addresses three case studies with their respective monuments [namely “Kilikien und Isaurien” (TIB 5); “Ostthrakien (Eurōpē)” (TIB 12); “Makedonien, nördlicher Teil” (TIB 16)] in order to research them carefully through the prism of Cultural Heritage (related to the before – after state of monuments), because of the current complex political and military situation in the Middle East with its repercussions for the monuments in situ (TIB 5) and because they comprise territories, the infrastructures of which are developing quickly and therefore changing the landscapes of the past at a fast pace with a strong impact on the respective monuments (TIB 12 and TIB 16).

Relevance for the conference: The submitted paper presents a unique and hitherto internationally unknown archival collection and its cultural as well as digital impact to an international audience in the capital of Austria.

Relevance for the session: Dig-TIB has the potential to illustrate how Visual Heritage can be introduced to the general public with concrete examples provided by the European Cultural Heritage.

Innovation: The innovative aspect of Dig-TIB is the fact that it addresses the notion of Long Term Data Archiving, which is in many fields a novelty in Byzantine Studies.

References:

- Mihailo Popovic, Veronika Polloczek, Digitising Patterns of Power (DPP): Applying Digital Tools in the Analysis of Political and Social Transformations in the Historical Region of Macedonia, 12th–14th Centuries. *medieval worlds: comparative & interdisciplinary studies* 5 (2017) 170-194. [peer reviewed];
- Mihailo Popovic, Bogdan Şandric, Transfer of (Historical) Geographic Knowledge Then and Now. From Static Data to User Oriented Visualization. *e-Perimetron, International Web Journal on Sciences and Technologies affined to History of Cartography and Maps* 7/2 (2012) 50-61.

Ylenia RICCI | Giorgio VERDIANI | Andrea PASQUALI, Italy

A petrified petrifying eyesight: a story for the MEDUSA’S HEADS from Istanbul, Turkey

Keywords: Photogrammetry, Virtual Reality, Istanbul, Medusa, Sculpture

Abstract: The Basilica Cistern, Yerebatan Sarnici in Turkish, it’s the largest of all the hundreds of ancient cisterns that rise below the city of Istanbul. In the North-West corner of the Cisterna, the bases of two columns reuse the carved blocks with the face of Medusa. The origin of the two heads is unknown, it is possible to say the same for a third (double) head located in the Archaeological Museum of Istanbul. These three/four heads of Medusa are masterpieces from the late Roman art. The research presented here starts from a digital photogrammetric study of this set of Medusa’s heads, this allowed to obtain a 3D digital model to study its morphology and shapes, then the model has been collocated inside the 3D virtual reconstruction of the Cistern in order to have an overall view. The assumption formulated here, with the cross referencing obtained during the research phase and digital photogrammetry, lead us to the idea that the heads may come from a Doric temple dedicated to Athena, in this specific case used as a metope, or from the triumphal arch dedicated to Constantine, in Constantinople. The aim is therefore to bring back to life, using a process of virtual reconstruction, with contemporary technology, such as virtual reality, an architectural element from the past, through a

virtual journey that traces the history of these stone giants, placing them in their hypothetical original context with augmented reality.

Relevance for the conference: Scientific reconstruction process and high quality survey combined towards public presentation

Relevance for the session: Significant use of digital survey tools and virtual multimedia to allow sharing and understanding of an artwork

Innovation: Step forward in understanding fragments from the ancient past

References:

- Önlü, Şehnaz. (2010) ANALYSIS OF STRUCTURAL ELEMENTS OF BASILICA CISTERN. Istanbul Technical University ;
- Freely, J. & Çakmak, A.S, 2004: Byzantine Monuments of İstanbul, Cambridge University Pres, London

Hugo A. SAMPAIO | João RIBEIRO | Ana M.S. BETTENCOURT | Manel SANTOS-ESTÉVEZ,
Portugal

Rescuing ancient carved memories: applying new technologies to rock art recording on the Northwest of Iberian Peninsula

Keywords: photogrammetry, carved outcrops, inventory

Abstract: Rationalist thought and great scale capitalistic economies lead western societies to deepen the gap between man and environment. Urban centers stress, technologies and gadgets, and modern ways of life promote the disconnection with nature and, in some regard, with past.

Due to this irreversible transforming progress, many forms of heritage are falling into oblivion or, in the worst scenarios, at risk. Especially those most fragile, such as rock art engravings. Much of these kinds of sites are unimpressive (since there are no constructions "marking" them), and difficult to identify. Stone quarries, forest fires, erosion, or constructions, are some causes responsible for its destruction.

On the other hand, it is considered that for past and pre-modern societies surrounding world was not inert but fully significant. Magical or odd creatures inhabiting outcrops, or special features attributed to them are currently present by legends and beliefs attached to carved surfaces.

In order to inventory these kinds of past traces, photogrammetric works have been developed in some Northwest Iberian Peninsula rock art sites. More than engraved signs, this technology provides the outcrops morphology recording. In this sense, new insights about this human past agency can be advanced, aiming to counter archaeological conceptions and narratives constructed on current assumptions.

Explain the relevance for the conference in one sentence:

The use of new technologies is part of the future to heritage disclosing, appreciation, and protection, especially rock art.

Relevance for the session: It is possible to acquire an image of carved outcrops more "readable" to the majority of people, disclosing a kind of past evidence in many cases unknown.

Innovation: The use of new technologies applied to heritage, and specifically to rock art, allows to recover, in many cases, hidden traces and messages of the paste.

References:

- Vilas-Estevez, B.; Vázquez-Martínez, A.; Carrero-Pazos, M. 2017. Going Further: (Re)Discovering Rock Art Carvings with Photogrammetric Techniques in Galicia (North-West Iberian Peninsula). In A. Ippolito, M. Cigola (Eds.) Handbook of Research on Emerging Technologies for Digital Preservation and Information Modeling (Chapter 8). Hershey: IGI Global, pp. 175-200.
- Ruther, H.; Chazan, M.; Schroeder, R.; Never, R.; Held, C.; Walker, S.J.; Matmon, A.; Horwitz, L.K. 2009. Laser scanning for conservation and research of African cultural heritage sites: the case study of Wonderwerk Cave, South Africa. Journal of Archeological Science 36: 1847-1856.

Martin SCHAICH | Tuna CAPAR, Germany

The Mycenaean site of Tiryns in 3D. High-resolution photogrammetry with Action-Camera on 6m rod and subsequent data fusion using 3D laser scans

Keywords: Data Fusion, Photogrammetry, Laserscanning, 6m rod survey

Abstract: The ancient site of Tiryns, located in Argolis in the Peloponnese (Greece), is a famous Mycenaean palatial center during the Late Bronze Age. The site was digitally recorded in May 2018 by ARCTRON 3D with the purpose of creating a detailed digital model of the complete site for a museum exhibition on Mycenaean Culture. The project has been commissioned by Badisches Landesmuseum (BLM) in Karlsruhe (Germany). The documentation was carried out by means of aerial and terrestrial images as well as laser scanning by a team of two 3D-surveying specialists within one week. Over 40.000 images were taken on site, and slightly more than half of these were processed to create a 3D model using the SfM approach. Additionally, terrestrial and hybrid-mobile laser scanning were deployed using two different sensors, namely Riegl VZ-400 and Leica BLK360. Since the site takes up many visitors, drone-photogrammetry as main surveying method was not possible due to permit and safety reasons. This situation on site necessitated an alternative method to acquire very low "aerial" photos. For this reason, a GoPro Hero 6 sensor placed on a gimbal was attached to a 6m fiberglass rod and used as a mobile "aerial" solution for image acquisition. In order to generate a complete and reliably scaled model of the site, data fusion using photogrammetry and laser scan was implemented. As a result of this work we can present an extremely detailed, accurate, photorealistic and stone-precise 3D-model of this famous Mycenaean castle. For the 3D documentation of such sites an efficient and cost-effective approach was realized. On account of the main purpose of the museum project, the model was reduced afterwards in size to generate a digital model to be used in real-time platforms such as VR and AR for interactive exhibition presentation.

Relevance for the conference: highly detailed stone-precise surveying strategy for archaeological ruins

Relevance for the session: data fusion of >25k Action-Cam photos with 3D laserscanning

Innovation: low "aerial" site documentation with gimbal controlled action camera on 6m rod

Konstantina SIOUNTRI | Dimitrios D. VERGADOS | Emmanouil SKONDRAS | Christos-Nikolaos ANAGNOSTOPOULOS, Greece

The use of augmented reality (AR) in the case of buried monuments

Keywords: 3D modeling, Augmented Reality (AR), Digital Culture, Digital Heritage

Abstract: The development of models in order to provide additional information to the visitors of archaeological sites through augmented reality (AR) has been an innovative process the previous years. This has been made possible due to achievements in digital technologies, communications, devices and developments in software engineering.

Nevertheless, the ways to fully make use of these new methods nowadays are still being explored as we have not exploited the potential of new technologies.

In archaeological sites, the production of 3D models for AR is focused on the virtual reconstruction of monuments as they were originally constructed, aiming to give to visitors, especially those who do not have special knowledge of archaeology, the third dimension (height, volume etc).

In this paper will be presented the innovative idea of using AR for maintaining the memory and the information of monuments, as they have been originally excavated but that are going to be buried due to the particularity of their material or their location. Also, the system architecture of the proposed scheme idea is going to be described through two study cases, a Neolithic settlement in the archaeological site of Halais, Lokris and the remains of a Classical Temple on open field of a hill in Thebes, Boeotia, that they are in the process of being covered again and “disappear” after providing all the possible data after being excavated.

Both of the mentioned monuments are under the direction of the American School of Classical Studies in Athens (ASCSA).

Relevance for the conference: Promotion of cultural heritage to the general public through Augmented Reality (AR)

Relevance for the session: Enhancement of Visual Experience of the past to the general public through AR

Innovation: Using AR for maintaining the memory and the information of buried monuments

Konstantina SIOUNTRI| Dimitrios D. VERGADOS | Emmanouil SKONDRAS | Christos-Nikolaos ANAGNOSTOPOULOS, Greece

The revival of buried monuments through Augmented Reality (AR)

Keywords: 3D modeling, Augmented Reality (AR), Digital Culture, Digital Heritage

Abstract: The development of models in order to provide additional information to the visitors of archaeological sites through Augmented Reality (AR) has been an innovative process the previous years. This has been made possible due to achievements in digital technologies, communications, devices and developments in software engineering.

Nevertheless, the ways to fully make use of these new methods nowadays are still being explored, as we have not exploited the potential of new technologies.

In archaeological sites, the production of 3D models for AR is focused on the virtual reconstruction of monuments as they were originally constructed, aiming to give to visitors, especially those who do not have special knowledge of archaeology, the third dimension (height, volume etc).

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Relevance for the conference: Promotion of cultural heritage to the general public through Augmented Reality (AR)

Relevance for the session: Enhancement of Visual Experience of the past to the general public through AR

Innovation: The use of AR for maintaining the memory and the information of buried monuments

References:

- Coleman J., Wren P., Quinn K., "Halai: the 1992-1994 Field Seasons", *Hesperia* 68 (1999), 286-338. [
- Bitely, Emily – Daly, Kevin – Jacob, Rob – Larson, Stephanie, *Geophysical Explorations on and near the Ismenion Hill, Thebes, Greece*, 2011.

Gilbert SOETERS, The Netherlands

Grandeur on the Market Square of Maastricht

Keywords: Town Hall, Film, Virtual Reality, Book

Abstract: The Maastricht Town Hall was built in 1659-1664 in neo-classical Style by the Dutch architect Pieter Post. The two powers which ruled the city of Maastricht, the Prince-bishop of Liège and the Duke of Brabant, shared the building for their governmental and legal tasks. Nowadays the Mayor and her Executive Councillors have their offices in the building. The public is only allowed in the central hall, but the real historical treasures like tapestries, pictures and the beautiful room decorations remain unseen. And it's also impossible to visit the hidden rooms in the cellar, the attic and the bell tower. Our main question was how to give the public access to this building and experience and explore the city hall like never before and how to give them adequate information on the proper level. We solved this by offering a threefold product: a short film for the right atmosphere with unique 3D images and fascinating close-ups, a virtual tour for the accessibility which will uncover unique places that you don't get see on the live tours and a traditional book for all the detailed information, featuring beautiful, high-quality photography. The book also offers background information on the interior and the impact of the conservation work.

Relevance for the conference: The Maastricht Town Hall will be visualised in different ways and made accessible for the public

Relevance for the session: a combination of different techniques to inform the public about this piece of heritage

Innovation: combining traditional and innovative techniques to inform the public on a proper level

Davide TANASI | Stephan HASSAM, USA

Learning through objects: 3D Digital Imaging and 3D Printing for public outreach in archaeology

Keywords: digital heritage, accessibility, touch interaction

Abstract: Archaeological museums are often perceived as repositories of relics, entrusted to preserve ancient material culture in perpetuity but at the same time committed to making it accessible. The fear of deterioration often denies access or imposes limits on the interactions between visitors and artefacts.

This contribution will present the results of three projects about archaeological heritage which has limited access and is not properly shared and communicated with the public: The Karam Collection of the University of South Florida, the Maltese prehistoric collection at the Museum of Siracusa (Sicily) and the Kouros of Leontinoi, scattered between two Sicilian museums. 164 objects were 3D scanned and the digital models were shared with the public using Sketchfab and the augmented reality app Augment. It is clear that digital renderings cannot replace real objects. Though they lack an existence in the real world, they make up for it by being available for experimentation and manipulation. In order to overcome the obvious limitations on tactile interaction with digital media, an alternative system was used, employing realistic 3D printed copies and haptic devices to afford the participation of members of the public with visual impairments.

Relevance for the conference: The contribution deals with digital applications on unpublished archaeological cases study

Relevance for the session: The cases study subject of the contribution represents the archaeological past of Sicily and Malta

Innovation: The innovation relies in the use of 3D printing and haptic technology for community engagement

References:

- Moritz Neumuller, Andreas Reichinger, Florian Rist, and Christian Kern, 3D Printing for Cultural Heritage: Preservation, Accessibility, Research and Education, in M. Ioannides, E. Quak, 3DResearch Challenges in Cultural Heritage, Springer 2014; pp. 119-134
- R. Scopigno, P. Cignoni, N. Pietroni, M. Callieri and M. Dellepiane, Digital Fabrication Technologies for Cultural Heritage (STAR), in EUROGRAPHICS Workshops on Graphics and Cultural Heritage (2014) R. Klein and P. Santos (Editors), pp. 1-8

Giovanni VERRESCHI | Antonio NOVELLINO | Davide PANTILE, Italy)

Exploracity: an innovative platform offering new services for the enhancement of Tourism and Cultural Heritage

Keywords: tourism; ICT platform; Augmented Reality; Virtual Reality; Cultural Heritage

Abstract: The “Exploracity” project is an innovative platform offering new services for the growth and the enhancement of Tourism flows and Cultural Heritage in Genoa. Financed by the MISE (Ministry of Economic Development), as part of Italy’s National Digital Programme, and created by ETT spa, Exploracity is the first systematic and communicative use in Italy of augmented and virtual reality for a complete multimedia tourist app.

Using innovative tools, Exploracity makes a city visit an immersive and evocative experience. Simple to manage, the use of geolocation mixed with virtual and augmented reality content means that each multimedia unit gives specific didactic content in a distinctive way and at differing levels, permitting cultural content to be enjoyed in an immersive and highly suggestive way, and encouraging in-depth learning of the history of Genoa's most important monuments.

Utilising both outdoor and indoor positioning functions, Exploracity is the perfect tool with which to plan a personal tourist route. Visitors can "live" the city and its parks, churches and museums, taking various and unexpected routes.

Each itinerary and on-site POI around the city contains videos, pictures, a mini virtual cultural-route, games, VR and AR experiences, as well as a collection of data and historical information. Much information on the typical life of citizens and on traditional artisan crafts is included.

In the "Mediaeval Itinerary", with its fifteen POIs, tourists can use a Cardboard viewer and watch immersive 360° video or pictures, discovering Genoa's past. A mix of VR and AR elements show today's city in its ancient magnificence, with the original monuments, churches, streets and squares. By listening to the narration and seeing every recreated secret corner, Genoa regains its original splendour right before visitors' eyes.

Relevance for the conference: An innovative Cultural Heritage enhancement platform to discover the history of a city through the most advanced technologies.

Relevance for the session: With the use of the latest media channels visitors can virtually travel back in time, reliving the past of Genoa to discover and experience the history of the city

Innovation: Exploracity is articulated in Information Touch Monitors, Virtual Reality Stations, 360-degree Views of the City and a Mobile App enriched with multimedia content and Augmented Reality.

References:

- https://www.youtube.com/watch?time_continue=25&v=KAVyo1o8pto
- <https://www.youtube.com/watch?v=6Xx-kVO2-RE>

Patricia WEEKS | Erik DOBAT | Christof FLÜGEL | Markus GSCHWIND | Carsten HERMANN | AI RAWLINSON | Sandra WALKSHOFER | Lyn WILSON UK

Advanced Limes Applications: Lessons in audience engagement and technology

Keywords: Antonine Wall, Mobile Information Systems, Augmented Reality, Limes, World Heritage;

Abstract: The extent to which in-situ remains of the Frontiers of the Roman Empire World Heritage Site are visible today varies greatly along this ancient border in the UK and Germany, and which originally stretched across 19 modern countries on three continents.

Archaeological finds are generally stored off-site, in museums far away from the excavated site.

Understanding the human history of a site becomes a challenge; all that remains are lines on the ground with no correlation to the individuals who built or inhabited those spaces. Conventional interpretation strategies rely on guide books, on reconstruction drawings and interpretation panels on site, and on visitors navigating the patchwork of archaeological sites and museums storing the associated finds. But if a site is so vast and so disconnected that no visitor can accomplish this easily, how can all the elements be brought into one place for them?

ALAPP seeks to combine the best of traditional interpretation alongside emerging technology to offer a layered approach to on-site interpretation. By re-uniting sites and artefacts, the human element is re-introduced. Different facets of information can be offered to appeal to different audience interests and the vehicle for the delivery of that information can be expanded from traditional interpretive approaches; the spoken word, video, 3D models, augmented reality. All from the comfort of the visitor's own mobile device.

This presentation will touch on: how content has been tailored to appeal to a range of different audiences; how content has been differentiated to utilise different media; how content becomes standardised internationally, creating an instantly familiar product; how different technological approaches have been utilised in creating the app; how technology is being adapted to suit international needs; and the lessons learned by the partners in seeking solutions to some of the challenges faced.

Relevance for the conference: The ALAPP project was granted funding from Creative Europe in 2016 to create an improved version of an existing app to enhance visitor experience at the Antonine Wall in Central Scotland and on the German Limes in Lower Bavaria; available on Android and iOS the project has seen collaboration between partners in Austria, Scotland and Germany

Relevance for the session: The Partners have learned much over the last two years about audience engagement and differences between countries in delivering interpretive programmes.

Innovation: ALAPP seeks to combine the best of traditional interpretation alongside emerging technology to offer a layered approach to on-site interpretation, re-uniting sites and artefacts, and reintroducing the human element.

References:

- Erik Dobat, Sandra Walkshofer and Christof Flügel. 2013. Mainlimes Mobil: Presenting Archaeology and Museums with the Help of Smartphones, In Nigel Mills, eds. Presenting the Romans – Interpreting the Frontiers of the Roman Empire World Heritage Site, Woodbridge, The Boydell Press (2013), 103 – 111.

Ways to visualize time

Chairs: Michael DONEUS | Geert Verhoeven, Austria

Any event can be located in space and time. While we are familiar with measuring and locating entities spatially, time is a qualitatively different dimension since it does not at all behave like any of the spatial dimensions. Whereas something can be stationary in one of the three spatial dimensions, one cannot stand still in time. Time always flows. In addition, archaeology has developed many tools to properly analyse and visualise the spatial component of archaeological data, but generally lacks convincing approaches to handle the time aspect, this despite the fact that time has for many decades been recognised as fundamental in both the theoretical, methodological and analytical archaeological discourse.

This session therefore seeks papers that explore and illustrate the breadth of avenues for analysing and visualising the time component embedded in archaeological data. Papers can present appropriate

theoretical and practical ways to deal with time in archaeology and cultural heritage, as well as recent original research on time visualisation.

Topics might include:

- Visualizing temporal aspects in GIS.
- Ways to detect, document, visualize and analyse change.
- Non-invasive approaches to identifying and visualizing temporal relationships in a landscape.
- Temporal aspects of heritage objects (e.g. astronomical orientation) and their documentation, interpretation and visualization.
- Depictions of time and temporal aspects on monuments, artefacts, or paintings.

Michael DONEUS, Austria

Deriving chronology from airborne laser scanning data

Keywords: LiDAR, harris matrix, topography, chronology

Abstract: Detailed topographic models derived from high-resolution airborne laser scanning (ALS) have become an essential source for archaeologists and heritage managers. So far, ALS is the only prospection technique, which can give detailed information on archaeological structures surviving under canopy on a regional and national scale. Additionally, ALS-derived digital terrain models come as 3-D datasets and a set of 2-D visualizations, which can be directly integrated with any other geographical data source and mapped in a GIS environment.

In current practice, archaeological structures from ALS-based DTMs are mapped on different levels ranging from a site-based strategy (i.e. identifying and inventorying a distinct group of structures as a site) to a detailed interpretation of each individual archaeologically relevant feature in spatial databases. While all of these approaches aim at a more or less coherent map of archaeological sites and structures, they cannot account for the complex sequence of (pre-)historic occupation of woodland, where areas have become repeatedly subject to a variety of uses. Any systematic mapping of these kind of 'palimpsest' landscapes will result in a multitude of intersecting lines squares, curvilinear and round features representing its long-term use. In order to understand this 'palimpsest', functional units need to be identified and chronologically put in order.

The presentation will demonstrate the use of a harris matrix to build a coherent chronological model of all mapped features from a complex case study. Each intersection displays a temporal succession of its features and therefore functions as a node within a stratigraphic sequence. Linking the resulting harris matrix with the GIS-based interpretation map, a relative sequence of archaeological structures can be inferred and functionally interpreted. The result is a diachronic sequence of human activity in a dynamic landscape.

Relevance for the conference: Temporal relations are derived from digital terrain models and visualized

Relevance for the session: Visualizing time in a landscape based on a combination of ALS-derived DTMs and a harris matrix

Innovation: Linking GIS with harris matrix and creating a 4D-analysis of a complex landscape

References:

- So far unpublished - First ideas on the topic in: Doneus M., Kühtreiber T., 2013. Airborne laser scanning and archaeological interpretation – bringing back the people. In: Opitz R., Cowley D., Interpreting archaeological topography – airborne laser scanning, 3D data and ground observation. Oxbow Books (Oxford), 32-50.

Matthias KUCERA, Austria

Archaeological space – concepts of space and time in archaeology

Keywords: Archaeological space, causality, relative and absolute time, speed of propagation

Abstract: Methods provided by archaeological sciences - in the first place archaeological prospection – enable the spatio-temporal analysis of archaeological evidence at the scale of landscapes. The resulting datasets represent the archaeological record of observed phenomena initiated or influenced by human activity in relation to other environmental parameters. For the traceable and reproducible analysis and interpretation of these observed phenomena, a clear definition of spatial and temporal relations and the respective characteristics and attributes of spatiality and temporality are crucial. An axiomatic definition of the four-dimensional archaeological space is fundamental and must include the necessary theoretical framework. This space consisting of three spatial dimensions and one temporal dimension has to be defined and constructed in order to enable the spatio-temporal analysis of archaeological landscapes. Time is therefore an intrinsic parameter of archaeological space and has to be characterized and defined in detail regarding its archaeological value and meaning. This is demanding for a closer understanding of temporal relations of events and processes represented by stratigraphic units (SU). Spatio-temporal analysis is therefore the analysis of the superposition of SU in the archaeological space represented by stratigraphic sequences. For this purpose the correct synchronization of various observed phenomena is within the focus of research. To synchronize events manifested within the archaeological record and observed at different localities, the speed of propagation of any exchange between these two sites is a necessary parameter, whereas each event is represented by a time interval. A first step towards a valid definition of time in archaeology is to differentiate between absolute time lines related to calendar dates and relative time lines related to the subjective perception of time of investigated cultures and the causal relevance for later events. The second step is to include these concepts together with the three spatial dimensions in the superordinate archaeological space.

Relevance for the conference: An accurate definition of the characteristics of archaeological space including temporal and spatial dimensions is fundamental for the correct analysis of content related to archaeology and cultural heritage.

Relevance for the session: As the session deals with the visualization and theoretical concepts of time in archaeology supplementary remarks regarding the overall theoretical framework of spatiality and especially temporality are demanding.

Innovation: Time and the spatial dimensions and respective attributes must be included within a superordinate archaeological space.

References:

- Günzel, St. (2010)(editor), Raum. Ein interdisziplinäres Handbuch. Springer Verlag GmbH Deutschland, 2010.
- Crema, E. R., Bevan, A., & Lake, M. W. (2010). A probabilistic framework for assessing spatio temporal point patterns in the archaeological record. *Journal of Archaeological Science*, 37, 1118–1130. 2010.

Vincent MOM | Joachim SCHULTZE | Sigrid WROBEL | Dieter ECKSTEIN, The Netherlands

Visualizing the development of the harbour of Hedeby

Keywords: Hedeby harbour, dendrochronology, visualization, Viking age

Abstract: The harbour facilities near the Viking city Hedeby in the north of Germany developed considerably during the period between 700 and 1000 AD. In 1979/80, a large research excavation was undertaken by K. Schietzel that exposed about 97% of the harbour area (2236 m²). 2044 timbers and 1641 post holes were uncovered which resulted in 264 dateable samples (Kalmring 2010). Information technology provides tools to combine and transform data from different sources into relevant information, and when 'dating-data' is available, then this makes it possible to introduce dynamics into the resulting visualizations.

For the harbour of Hedeby we developed a visual tool, using the available dateable wood samples: their year ring patterns were compared, one by one, to calculate the 'distance' of each pair of samples: the smaller this distance, the larger the chance that two samples are from the same tree, which provides interesting information about wood usage strategies. The resulting distance matrix was used to do a clustering of the samples. A second source of data was the end date (felling date) of the samples. And the third was the find spot of the sample, as indicated on the excavation maps. The tool offers a number of basic functions like showing (clusters of) samples on different excavation maps. Apart from that, the tool shows the dynamics of the harbour's development: one can specify a period's start- and end-date and the tool will show, year by year, the harbour's extensions. Especially in the years 881 and 885 AD substantial developments took place.

Relevance for the conference: A new tool that dynamically visualizes the development of the harbour of an important early-medieval settlement, based on the integration of different data sources.

Relevance for the session: The dynamic developments show the different periods of increased activities over time

Innovation: Combining the clustering of wooden samples, based on their year ring patterns, combined with other other data to search for 'same tree' samples is new

References:

- Allocating Archaeological Wood Samples to a Common Source Tree and Its Use for Analyzing Wooden Settlement Structures (Mom, Schultze, Wrobel and Eckstein, CAA 2009)
- Der Hafen von Haithabu (Kalmring, 2010)

Erik SCHMITZ, The Netherlands

Time Markers. Years on gable stones and tombstones in pre-modern Amsterdam

Keywords: Amsterdam, monuments, gable stones, tombstones, social differentiation

Abstract: In a small alley in the centre of Amsterdam, today hardly noticed by anyone, an old gable stone reads: '1748 in troubled times founded / in times of peace perfectly build / in the Lord my hope is grounded / in whom I will be fulfilled (rendered from Dutch).

This stone connects the building of a new house to a specific historical event, the War of the Austrian Succession (1740-1748) and thus puts it firmly in the times experienced by the citizens of Amsterdam and the Dutch Republic. It is also a sign of piety, referring to afterlife, the time after death.

In pre-modern Amsterdam, most houses were marked by a gable stone showing an image, e.g. a scene from the Bible or an object related to the owner's occupation, and often mentioning the year of construction (as did simple year-stones). They were markers of place. But mentioning a year meant marking time. This contribution looks into the distribution of these time markers and the differences between residential areas. Which social groups needed to mark their time?

Like the houses of the living, the houses of the death were marked too. Tombstones in churches, much more public spaces than nowadays, served as time markers of life after death. How do they compare to the time markers along the streets and canals of the city?

Relevance for the conference: Using modern techniques to get an overview of scattered data and put them in historical perspective.

Relevance for the session: How to understand temporal markers used in pre-modern Amsterdam.

Innovation: Year-stones are a neglected source of information and should be treated as key-elements in understanding how people in the past marked their own time.

References:

- Onno Boers, *De gevelstenen van Amsterdam*, Amsterdam 1992

Santiago VILLAJOS, Spain

A multiscale relational approach to Early Modern Architecture: Francisco de Luna and Andrés de Vandelvira in Uclés or the admonition of the sailed dome in Spain

Keywords: Stratigraphy, biographies, architecture history, 3D GIS, grotesque theory

Abstract: Interdisciplinary research is presented in order to understand and to explain the processes of planning and building the Uclés Monastery in relation to the architects Francisco de Luna and his son-in-law Andrés de Vandelvira, who was one of the most important artifices of the Early Spanish Renaissance. It combines SfM photogrammetry with 3D GIS and an originally developed contextual-sequential stratigraphic approach to the social networks of architects and the agency of their productions. The use of this hybrid method is inspired in the material and historical notion of the grotesque developed by Ruskin in 'The Stones of Venice'.

Time is dealt from a stratigraphic and synthetic comparative perspective which connects the particular materiality of the case study to the more abstract set of social connections that shaped the architectural world in which it was produced. On the one hand, the set of stratigraphic relations within the architectural structure are expressed visually through 3D GIS and analytically through Harris matrices produced with network analyses software. On the other hand, the connections

in the social world are carried out also on a matrix produced in spreadsheet software that plots chronology in relation to the masters's works, so it affords to provide sequential ordering of events to the major developments of the period by following the approach to style of George Kubler.

This methodological contribution to heritage studies, moreover, provides relevant information for understanding the adoption of the sailed dome in Early Modern Spanish architecture that was an 'stilema' of Vandelvira, but traditional scholarship had not related him with the Byzantine dome of the Uclés Basilica, even though it was known the project was interrupted. Research demonstrates the vaulted dome was first projected by Vandelvira in Uclés in collaboration with Francisco de Luna and Enrique Van Eyck, also known as Enrique Egás.

Relevance for the conference: Innovative interdisciplinary digital approach for solving specific questions on the understanding of heritage architecture.

Relevance for the session: It looks at time from multiple scales (period, phase, stratigraphic unit, biographies) through a combinación of methods

Innovation: It mixes visual documentation obtained from SfM photogrammetry within archaeological analysis of both stratigraphic units and compared biographic and constructive sequences

References:

- George Kubler and John Ruskin

Gabriel WURZER | Christoph HOFFMANN | Elmar SCHMIDINGER | Herbert WITTINE | Richard KURDIOVSKY | Julia FORSTER | Andreas VOIGT, Austria

Lessons learned from building a time-attributed partonomy for the 4D-visualization of the Vienna Hofburg

Keywords: Partonomy, 4D Visualization, Vienna Hofburg

Abstract: 4D visualizations of heritage commonly use time-attributed geometry in order to show the progression of building history through successive phases; however, modelling such a progression is hard geometrically and semantically because a building undergoes constant change (i.e. additions, removals, merge and splits of model parts, potentially at a very small level) and furthermore the notion of a "building part" itself is fuzzy - a room which was known as „First antichambre“ at a certain time, might belong to a completely different in a next phase due to remodelling works – even if the function and naming of the room did not change. Decomposing a building into a strict hierarchy of parts-within-parts is thus not possible. The authors have instead opted to use a partonomy - i.e. a structure describing part-whole relationships in an abstract way, where time spans, concrete geometry and documentation may be added as an attribute afterwards. Using this concept, it is possible to inherit information from parent parts; it also makes modelling of building parts having a fuzzy definition easier. However, it would be unfair to say that this data structure solves every problem associated with building history, as was found out during practical work concerning the 4D visualization of the Vienna Hofburg. To share our insights also with view to other projects that might benefit from using partonomies is our goal in this paper. In more detail, we will present our prototype visualization and take a look behind the scenes so as to show how the visualized data is fetched from the partonomy. We will also be describing possible ways of using inheritance for attributing information, which can

help structure information more efficiently. We are sure that the contribution will serve a wider audience occupied with modelling heritage as a reference.

Relevance for the conference: Partonomies are highly relevant for representing building history, which is why we wish to summarize lessons learned when applying them for the Vienna Hofburg "Quellenspeicher" project

Relevance for the session: Representing time in a partonomy offers significant advantage due to abstraction and inheritance among represented objects

Innovation: The contribution lies in applying partonomies to a concrete project, and sharing the lessons learned in that context with the audience

References:

- Friedrichs K., Münster S., Kröber C., Bruschke J. (2018) Creating Suitable Tools for Art and Architectural Research with Historic Media Repositories. In: Münster S., Friedrichs K., Niebling F., Seidel-Grzesińska A. (eds) Digital Research and Education in Architectural Heritage. UHDL 2017, DECH 2017. Communications in Computer and Information Science, vol 817. Springer, Cham;
- Richard Kurdiovsky, Günther Buchinger, Renate Holzschuh-Hofer, Markus Jeitler, Herbert Karner, Anna Mader-Kratky, Paul Mitchell, Anna Stuhlpfarrer & Werner Telesko (2015) Legitimacy through History and Architecture. The Vienna Hofburg as Dynastic Hub and Seat of Government between Tradition and Innovation, *The Court Historian*, 20:2, 109-136, DOI: 10.1179/1462971215Z.00000000017

Georg ZOTTI | Florian SCHAUKOWITSCH | Michael WIMMER, Austria

Changing Sceneries under Changing Skies: Virtual Archaeoastronomy with Stellarium

Keywords: archaeoastronomy, virtual archaeology, simulation

Abstract: A major topic in archaeoastronomy is the orientation of human-made monuments with respect to the surrounding terrestrial and celestial landscape. There are many examples of temples oriented towards sunrise on solstices or other culturally important dates, and the orientations of many more structures are under discussion, concerning relations to the Sun, Moon, planets and even some of the brightest stars.

Time and geographical coordinates are the key parameters from which the celestial view is computed with a desktop planetarium program. Developments in the popular open-source project Stellarium in recent years were particularly directed towards enhancing its applicability for archaeoastronomical research. Stellarium can display a calibrated panorama horizon which enables a virtual observer to embed himself in one particular viewpoint. With an optional extension it is even possible to load 3D scenery, usually a combination of terrain and virtual reconstruction of the monument in question. A researcher can walk around in this virtual world and observe along monument axes, building edges, or even patches of sunlight as they may have been visible falling through holes in a wall centuries ago. A problem for most 3D virtual reconstructions of archaeological monuments is that they show a static snapshot of a landscape as it may have looked like at a certain point in time. Showing the next "monument phase" requires loading a new file, which distracts the observer. With

archaeoastronomically significant directions slowly changing over centuries, we also should not show the monument under an astronomically wrong sky.

The most recent change in Stellarium's 3D mode allows temporal changes not only in the sky but also in the 3D scenery. Parts of the model which do not fit the simulated time can be hidden by transparency, which also allows for modelling temporal uncertainty.

Relevance for the conference: Simple and accurate simulation of the astronomical orientation of archaeological monuments can be important both for research and outreach.

Relevance for the session: The 3D simulation of monuments under the skies of past times for archaeoastronomy research can now display temporal changes not only in the sky but in the monuments themselves.

Innovation: A simple rendering trick allows showing temporally changing parts of monuments in an archaeoastronomical simulation environment.

References:

- Georg Zotti. Archaeoastronomical simulations in a desktop planetarium. In Wolfgang Börner, editor, CHNT20: Conference on Cultural Heritage and New Technologies, Proceedings CHNT2015, volume 20. Stadtarchäologie Wien, October 2016.
- Georg Zotti, Florian Schaukowitsch, and Michael Wimmer. Beyond 3D Models: Simulation of Phased Models in Stellarium. In Proceedings of the 2017 SEAC Conference, To Appear.

What to do with all the 3D data?

Chairs: Vera MOITINHO DE ALMEIDA, Austria | Dirk RIEKE-ZAPP, Germany

This session invites contributions dealing with a number of aspects related to 3D data in cultural heritage, particularly those that go beyond the process of 3D data acquisition and simple visualisation. Many of us have: (1) spent quite some time optimizing acquisition techniques (e.g., structured light or laser scanning, photogrammetry, CT scan, digital microscopy, procedural modelling); (2) started sharing or reusing data on/from databases or online; (3) and more recently, analysing particular sets of data. However,

- why do you generate 3D data?
- What kind of data is required for certain type and scale of scientific analysis?
- What type of quantitative and/or qualitative analysis (e.g., acoustic, functional, morphological, simulation, statistical, structural, technological, thermal, visibility, volumetric) do you carry out on the 3D data to help answering your research questions?
- How does the 3D data workflow determine the interpretation of the cultural heritage object and/or dataset?
- And how do you structure and save these data for long-term archiving and accessing?

This session would like to summarize concepts, to encourage critical evaluations of used approaches, and to spark the discussion on requirements and methods mainly for 3D data analysis and interpretation of cultural heritage assets.

Francesco GABELLONE | M. CHIFFI | M. DECKER | D. TANASI, Italy

Integrated survey technologies for the conservation and dissemination of the Roman mosaics of Piazza Armerina (Sicily)

Keywords: Mosaics, photogrammetry, armerina, scanner, usf

Abstract: The Roman villa of Casale at Piazza Armerina (Sicily), is among the most significant examples of Later Roman villas in the Mediterranean. Its typology, extension and location echo the wealth and power of the owner of the largest agricultural estate in Roman Imperial Sicily. The luxurious mansions is well known for the style of its mosaic floors dated around the 4th century CE, recognized by scholars as the most beautiful for Roman culture.

Such archaeological treasure is an invaluable iconographic source informing us about lifestyle and habits of Roman aristocracy and its economic and cultural interaction with north-African provinces.

The villa has an extension of about 3,500 square meters and it counts 48 rooms with mosaics floors crafted by north-African artisans still in excellent conditions. Such stone tapestries elucidate scenes of daily life, depiction of heroes and deities, hunts and games. In summer 2017, an interdisciplinary team of scholars carried out an integrated digital survey of the entire complex including the mosaic floors.

With respect to the mosaics, the goal was that to document the conditions and to design an alternative and virtual enjoyment experience with a degree of realism as close as possible to reality. For this reason, laser scanning and digital photogrammetry were employed and combined in order to obtain an accurate metric reference (laser scanner) and a high resolution color information (digital photogrammetry). The heterogeneous light environment of the different rooms and the control of errors generated by the measurements have represented the most challenging aspect of the project. The preliminary results have been organized in a high resolution visualization platform with the option of altitude maps and detail level up to the size of a single tessera

Relevance for the conference: Villa del Casale: very extended survey of most important mosaics in roman age

Relevance for the session: Integrated methods of survey. Management of complex light illumination for photogrammetry issues

Innovation: HD platform for dissemination. 3200 square meters of mosaics displayed at the resolution of the single tessera

References:

- P. Pensabene, Piazza Armerina. Villa del Casale e la Sicilia tra tardoantico e medioevo

Vera MOITINHO DE ALMEIDA | Dirk RIEKE-ZAPP, Austria

Brief notes on 3D Accuracy, Precision, Resolution, and Uncertainty

Keywords: Accuracy, Precision, Resolution, Uncertainty

Abstract: Cultural Heritage (CH) objects encompass a wide diversity of materials, colours, shapes, textures, and patterns amongst several other characteristics. Understanding these, their roles, and their combinations allows insight to the interrelationships between them, as well as insight into issues such as: material provenance, manufacture, function, knowledge networks, and human mobility. On the other hand, this understanding may also help in predicting and comprehending their occurrence in new contexts. As such, the need and concern for the documentation and description of CH objects is

unequivocal; that these methods are reliable, and that procedures and techniques are internationally accepted. But, of course, it is the scientific question one wishes to answer that determines the key properties that need to be documented and described in any given situation for a given CH object. Metrology is the science of measurement and its application. Measurement error is ubiquitous in scientific work. Accuracy, Precision, Resolution, and Uncertainty are terms that are well defined in the literature and, for this reason, they should not appear “abstract” for applications to CH. Proper use and reference when discussing these terms are very important when working with any type of measurement technology, as inaccurate, imprecise and low-resolution measurements with a high level of uncertainty may most certainly lead to erroneous interpretations of CH objects.

Relevance for the conference: To clarify a set of key terms often misunderstood and typically misused in Cultural Heritage, but of utmost importance for an efficient and reliable documentation, analysis, preservation, and sharing of CH assets.

Relevance for the session: To clarify a set of key terms often misunderstood and typically misused in Cultural Heritage, but of utmost importance for an efficient and reliable documentation, analysis, preservation, and sharing of CH assets.

Innovation: A thorough understanding of these key terms is necessary to develop critical methods, as well as suitable and user-oriented solutions for a given task.

References:

- Moitinho de Almeida, V., Rieke-Zapp, D. (2017). “Generación de datos 3D con sistemas ópticos de medición de corto alcance”. In *Arqueología Computacional. Nuevos enfoques para la documentación, análisis y difusión del patrimonio cultural*. D. Jiménez-Badillo (ed.). Mexico: Instituto Nacional de Antropología e Historia (INAH). Pp.93-109. (ISBN: 978-607-539-027-7)
- Moitinho de Almeida, V., Wefers, S., Murphy, O. (2017). “An Interdisciplinary Discussion of the Terminologies used in Cultural Heritage Research”. In *Digital Techniques for Documenting and Preserving Cultural Heritage*. A. Bentkowska-Kafel & L. MacDonald (eds.). Plymouth: ARC Humanities Press. Pp.3-16. (ISBN:9781942401346)

Erica NOCERINO |Dirk RIEKE-ZAPP | Vera MOITINHO | Elisabeth TRINKL, France

Mapping vis and UVL imagery on 3D geometry

Keywords: Multispectral, Luminescence, 3D

Abstract: The paper presents an interesting investigation about the combination of multispectral and 3D imaging aiming at the analysis of the condition and preservation of an ancient vase. In particular the work reports the combination of ultraviolet-induced luminescence (UVL) and visible-reflected (VIS) imaging with image- and range-based 3D modelling. The most frequently used reflectance imaging techniques are visible-reflected (VIS or VISR, corresponding to standard photography, i.e. the acquisition of RGB colour information), infrared-reflected (IRR) and ultraviolet-reflected (UVR), while luminescence imaging methods include ultraviolet-induced luminescence with emission in the visible range (UVL or UIL), visible-induced visible luminescence (VIVL) and visible-induced infrared luminescence (VIL). VIS corresponds to standard photography: images are generated using visible radiation and collecting the reflected light in the visible region. It hence provides reference images to

interpret images produced from other multispectral techniques. The case study is an Attic vase, part of the pottery collection of the Landesmuseum Rudolfinum (Carinthia, Austria) and temporarily stored in the Institute of Archaeology of the University of Graz, Austria. The aim of this investigation is to exploit the added-value provided by mapping multispectral imaging onto 3D geometry for a comprehensive knowledge of the condition of a restored Cultural Heritage (CH) item. The presentation will also compare and discuss different 3D surface scanning techniques and imaging strategies for a wider range of applications.

Relevance for the conference: Combination of 3D and 2D data for quantitative analysis and visualization

Relevance for the session: Combine different methods to get more out of the data

Innovation: Combine different methods to get more out of the data

References:

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- Mara, H. and Portl, J., 2013. Acquisition and documentation of vessels using high-resolution 3D-scanners (pp. 25-40). Verlag der Österreichischen Akademie der Wissenschaften (VÖAW).

Markus PÖCHTRAGER | Georg HOCHREINER, Austria

Numerical visualization of points from laser scanning in terms of the structural behavior of historical timber structures pressed for time

Keywords: historical timber structure; structural model; point clouds

Abstract: A fast assessment of the condition of historic timber structures is important in case of sudden damage or while renovation work. In angled and complex timber constructions surveying with tachymeter is time consuming and requires additional manual post-processing work for a modelling of the wooden beams and their joints. The technology of 3D laser scanning has evolved significantly in recent years and already allows the measurement of several hundred thousand points per second. Thus, point clouds covering an entire timber construction can be recorded quickly from several scanning positions. Yet, the manual modelling of beams from the laser scanning point clouds is still a work-intensive task. The development of automated geometric modelling from point clouds is driven forward intensively with the goal of overcoming the bottleneck in manual modelling. Developed methods like triangulated mesh generation or parametric modelling (e.g. NURBS or simple geometric solids) are finding their way into more and more application areas. A geometric fact finding about beams of the historic timber structures is required to contain at least information about the beam axis and dimensions. For a subsequent structural analysis the detection woodworking joints and the assignment of joint characteristics with respect to structural performance is of importance. The requirements for a reliable structural assessment –e.g. in terms of geometric accuracy, completeness of the geometric model as well as beam and joint characteristics– need to be discussed for different levels of detail (e.g. ideal straight beams, deformation of beams, cracks and damages on beams). While an elaboration with current manual methods for geometric and subsequent structural assessment takes weeks, our vision is to develop a method for a highly automated assessment within

some hours respectively a few days. A fast automated structural assessment enables monitoring of existing structures with respect to progressive structural failure in the future.

Relevance for the conference: This work provides an approach for an automated computation of visual structural models for historical timber structures and discusses the requirements for a reliable structural assessment.

Relevance for the session: In many historical timber structures laser scans are made and plans are drawn, but the important information about the structural systems are not extracted because it is too time-consuming.

Innovation: We present innovative ideas for a highly automated computation of structural models of historic timber structures.

References:

- Pöchtrager, M., Styhler-Aydin, G., Döring-Williams, M., & Pfeifer, N. (2018). Digital reconstruction of historic roof structures: developing a workflow for a highly automated analysis. *Virtual Archaeology Review*, 0. doi:<https://doi.org/10.4995/var.2018.8855>
- G. Eßer, G. Styhler-Aydin, G. Hochreiner: "Construction History and Structural Assessment of Historical Roofs - an Interdisciplinary Approach"; in: "Proceedings of the Structural Analysis of Historical Constructions - Anamnesis, Diagnosis, Therapy, Controls", K. Van Balen, E. Verstrynghe (Hrg.); Taylor and Francis Group, London, 2016, ISBN: 978-1-138-02951-4, S. 790 - 795.

Alvaro SANCHEZ CORROCHANO | Enrique MARTINEZ SIERRA | Natalia GONZALEZ PERICOT, Spain

The “Salón de Reinos” of the Prado Museum analysed through photogrammetry and 3D laser scanner for a detailed survey previous to intervention

Keywords: heritage, photogrammetry, laser scanner

Abstract: Nowadays there are techniques and digitalization tools to facilitate and improve data collection process to users. Photogrammetry and laser 3D scanner have marked a before and an after in the work of digitization of the built elements, allowing to streamline data collection and maximizing the information provided.

Its high geometric precision, thoroughness, performance retrieved and especially the generation of high fidelity and precision of architectural good assets make these tools optimal for the planimetric surveys.

So this technique, using 3D model, can be not only an instrument for a dimensional and morphological survey of Cultural Heritage but also a tool to obtain a general knowledge of the building, in terms of construction techniques, materials and state of conservation. In order to enlarge the use of this technique principally for pre-design project, all the information can be re-organized inside a database to control all the different phases of the building process.

This work presents the application of these techniques on the “Salón de Reinos” (Hall of the Kingdoms) of the Prado Museum, to several objectives: the first one, to obtain a detailed drawing up to gather a deep constructive knowledge to determine the exact layout of the constructive elements for their structural consolidation. The second objective is related to the exterior of the building, where

photogrammetry adds to 3D models information such as textures and a higher level of detail. The combination of 3D laser scanner and photogrammetry can provide the base to build a virtual reconstruction of different periods of a cultural asset if they are nurtured by the information retrieved on the historical records.

Relevance for the conference: new technologies applied to heritage

Innovation: combination of new documentation technologies

Gunnar SIEDLER | Sebastian VETTER, Germany

Methods for 3D-documentation of mural paintings

Keywords: 3D-Objectdocumentation, textured surface model, ortho projections, 3D mapping

Abstract: Due to experiences in the field of documentation for heritage conservation and software development the authors have got background knowledge to develop methods for image processing and digital mapping. The aim of the work was a true to scale image plans in the scale of 1:5 to 1:10 for a resolution of 400 dpi. The selection of the right procedure like 3D unwrapping and ortho projection using a digital surface model or textured surface model is always done depending on object geometry and requirements of the conservation project.

The recording of the object surface by 3D laser scanning or digital photogrammetry (Structure from Motion) is needed for curved surfaces (vaults, apses) and structured or deformed surfaces (walls, ceilings, floors). Both procedures have got advantages and disadvantages that will be shown on several projects.

Today it is possible to create a textured surface model with sufficient image resolution for smaller objects like the vault of the chapel St. Joseph in Isny (13m x 17m). But that assumes appropriate hardware (graphic card) for an efficient evaluation of the data by the user.

The procedures will be explained at different medieval mural painting projects. But they can also be used interdisciplinary for documentation projects, which need high photo quality. In addition to this, it is possible to combine additional images in different colour spaces (like UV light, infrared or historical images) with each of the explained methods.

Due to close cooperation with conservators during development process surface models no longer serve only for presentation but can also be used for true to scale evaluation in the field of conservation. Current developments like the automated image orientation on the base of textured surface models to create multi textured surface models will be shown within this paper.

For 3D mapping on surface models we have developed tools for line and area mapping, that allow cutting of 3D areas, integration of vector symbols and annotations known like in 2D mapping too.

Additionally segmentation of large and complex surface models and 2D model views with orthogonal projection for printing output support 3D mapping on surface models.

Relevance for the conference: The shown procedures are documentation methods for 3D objects that need high photo quality.

Relevance for the session: With the current R & D project "PROQUATO" tools and methods are developed for efficient 3D evaluation of multi textured surface models.

Konstantina SIOUNTRI, Greece

The three-dimensional digital representation of South Stoa (Portico) and Agonotheton mosaic in Ancient Corinth, Greece

Keywords: digital heritage, 3D modeling, 3D data analysis

Abstract: Ancient Corinth is one of the most significant archaeological sites in Greece, due to its historical importance as a Panhellenic administrative and commercial center in the late Classical and early Hellenistic times and due to its impressive monuments, i.e. the Apollo temple, the Altar of Paul the Apostle etc.

Among these monuments, there is the "South Stoa", an impressively large building, which covers an area of more than 4 acres (165 m long and 25 m wide) and consists of: (a) the portico, the northern part - facade with the outer and inner colonnade and (b) the southern part with Hellenistic shops and Roman public buildings. Between the southern buildings, there is the roman "Agonotheteion", a monument that includes a 45 sq. m., also known as "Eutychia" (good luck) mosaic.

The study group, which was set up and organized by the paper's author for the American School of Classical Studies in Athens (ASCSA) and the Hellenic Ministry of Culture, carried out an ambitious project of proposing the restoration of the South Stoa Portico (reformation of the ground elevations, reconstruction of the boundaries, replacement of the archaeological remains etc) and the conservation of the Agonotheteion mosaic.

In order to complete the study of the two monuments, which due to their size, nature and construction were completely different, our team had to thoroughly document the geometry and to fully map the pathology of the objects, either we had to deal with the 165 m. colonnade or a single mosaic chip. For that reason, we had to carry out measurements with absolute precision and to document all the details of the colors and textures.

The method of photogrammetry and the construction of 3D models, which was used for the project, was the key factor since it helped us with all the above issues and it allowed us to correct with high accuracy the initially published dimensions of the portico, to identify its initial level, to process efficiently a big quantity of information and to guarantee the safe detachment and movement of the mosaic. As far as it concerns the mosaic, the detachment has already been completed and its conservation is in progress.

Relevance for the conference: This paper presents the use of the 3 d representations in restoration, conservation and enhancement of ancient monuments

Relevance for the session: This paper presents implemented case studies of using and structuring digital data in order to interpret and monitor cultural heritage

Innovation: The implemented 3D representation projects of the proposed paper on different types of monuments in Ancient Corinth succeeded to deliver accurately structured data dealing with issues of monitoring geometry and pathology, by correcting problems of the past and avoiding mistakes on restoration of the future

References:

- O. Broneer, Corinth I.IV: "The South Stoa and its Roman Successors", Princeton – New Jersey, 1954

- “Good Luck” from Corinth: A Mosaic of Allegory, Athletics, and City Identity Betsey A. Robinson American Journal of Archaeology Vol. 116, No. 1 (January 2012), pp. 105-132

Ruth TENSCHERT | Max RAHRIG | Rainer DREWELLO | Sebastian KEMPGEN, Germany

Scratches? Scribbles? Scripture! Revealing the unseen – 3D scanning of Glagolitic graffiti of the 10th century at Saint Naum

Keywords: 3D Scanning, Cultural Heritage, Graffiti, Surface Analysis, Revealing Lost Inscriptions

Abstract: The Monastery of Saint Naum in Macedonia is part of the UNESCO World Heritage Site “Natural and Cultural Heritage of the Ohrid region”. The area is unique not only for its architecture but also its outstanding linguistic heritage. The monastery was named after Saint Naum and founded at the end of the 9th century and is visited by many tourists every day. In the transition from the narthex to the central church, the visitor immediately notices two shiny white marble columns. These columns carry unique inscriptions/graffiti, which represent some of the earliest evidence of the Glagolitic alphabet in Macedonia, a precursor of the Cyrillic alphabet. During the project, previously unseen inscriptions were revealed on the columns.

The huge number of tourists poses a danger to the historic surfaces of the columns, as the constant touching and rubbing of the inscriptions is causing deterioration. Therefore, there is an urgent need to image and archive the inscriptions. Using macrophotography with raking light on the columns did not work well as the curvature and shiny surface caused blurring in the images, and some of the graffiti were not visible. Therefore, a structured light scanner with a 3D point resolution of 30 µm or less was used to record the columns and both preserve and reveal these unique graffiti. The recording of the surfaces was deliberately carried out without texture information to exclude errors caused by the shiny and discoloured marble of the columns. The resulting high resolution 3D model can be virtually illuminated at any angle, for example using raking light, allowing detailed observations and analysis. In addition to digitally preserving and archiving the inscriptions, the resulting surface models can be easily accessed by Slavistic and linguistic experts for a variety of research purposes.

Relevance for the conference: It’s about visualisation of unseen inscription using high resolution structured-light-scanning.

Relevance for the session: Active use of 3D Data to reveal lost evidence of Glagolitic inscriptions

Innovation: Innovative combination of digital heritage documentation and linguistic research

Elisabeth TRINKL, Austria | Dirk RIEKE-ZAPP, Germany

Face to face and beyond

Keywords: Measurement, quantification, head vase

Abstract: The vast majority of the Attic pottery is thrown by the spinning wheel. Concerning head vases the potters used the same technique only for the upper part of the vessel whereas the head of the head vase was made by two moulds, one for the face and a second for the rear; finally some facial details by hand. 3D scan models of several vases were selected for comparison. We are convinced that Beazley’s classification of groups dating back to 1929 are principally correct. Nevertheless, recent computer technology and visualization systems can help to further refining and consolidating the original groups, in respect to chronology and production process. Digitization of several head vases

with fringe projection systems in different museums allowed for digital comparison of vases. Calculating the difference of the resulting 3D models after co-registration revealed very little differences between the head areas of several vases. Differences are so small that it is likely that the same mold was used for several preserved head vases. Scaling the digital models by 10-15% in order to simulate the volume loss during production of a head vase. Comparing results, it is not unlikely that molds were taken as negatives from oven burned head vases to produce a generation of smaller head vases.

Relevance for the conference: Use 3D data for quantitative analysis to test ideas and theories

Relevance for the session: We produced 3D data for measurements and developed additional ideas

Innovation: Bring metrology to archaeology

References:

- Beazley, J. D, 1929. Charinos, JHS 49, 1929, 38-78;
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Round Tables

Advances in Image-based 3D Reconstruction and Modelling (SfM/MVS)

Chairs: Benjamin DUCKE, Germany | Giorgio VERDIANI, Italy

Structure from Motion (SfM) and Multi-View Stereo (MVS) are applied research areas of Computer Vision (CV) that have revolutionized the way archaeologists, heritage professionals and scholars design and practice 3D data acquisition, modelling and publication.

With image-based technologies, full 3D capturing and publication has become available at an unprecedented level of flexibility and versatility. But the image-based approach also comes with its own set of significant challenges, such as incomplete reconstructions, unsuitable input images and bottlenecks in processing resources (CPU time, memory, storage space, online bandwidths). As software, hardware and acquisition practice evolve, these issues are being addressed in incremental steps of Innovation.

This round table aims to provide an interactive environment in which participants can show-case and discuss problem solutions and innovative workflows that aim to improve current practice and output data Quality.

We invite contributions (technical case studies, project reports, software, etc.) that address some of the many technological issues in and around the area of SfM/MVS, such as:

- Camera calibration, extreme optics and environmental conditions.
- Image preprocessing and enhancement tools for better visual quality.
- Robust and geometrically accurate 3D surface reconstruction (“meshing”).
- Fast and reliable image matching for very large image series.
- Feature detection in low-contrast and weakly textured images.
- Flexible processing pipelines for automated 3D reconstruction.
- New developments in free and open source software for 3D processing.
- Computational efficiency and concurrent processing (multi-core CPU and GPU utilization).
- Advances in hardware for 3D data acquisition.
- Open file formats, metadata and semantic data structures for publication and re-use.
- Online platforms for open access 3D data publication and archiving.

Marco BLOCK-BERLITZ | Christina FRANKEN | Hendrik ROHLAND | Alexander HAFERLAND | Benjamin GEHMLICH | Niklaas GÖRSCH | Hilmar BOCHMANN, Germany

Documenting more than 8000 ha in Mongolia in ten days using low-cost drones

Keywords: Mongolia, UAV, low-cost, 3d reconstruction

Abstract: Over the last decades, progress in developing Unmanned Aerial Vehicles (UAV) and 3d reconstruction software is noticeable, which extends into documentation methods in archaeology as a standard component. In a little while, UAVs record data automatically and 3d reconstruction software

produces georeferenced 3d models to map i.e. excavation steps accurately. Different tools are available to record data automatically. The archaeocopter team (HTW Dresden, Germany), and the German Archaeological Institute (DAI), the Mongolian Academy of Science (MAS) and the Mongolian State University work together in a documentation campaign in Mongolia in October 2018. The objective of the campaign is the documentation of remaining surface structures of two major archaeological sites in Mongolia: Karabalgasun, the capital of the Uyghur Empire from 745 to 840 CE and Karakorum, the capital of the Mongol Empire from 1220 to 1260 CE. Both are located in the UNESCO world heritage site of the Orkhon Valley and are subject to Mongolian-German joint research efforts since 1999. Beside relatively small documentations in Karakorum of about 500 ha, the team records large-scale areas of about 8000 ha close to Karabalgasun. It was necessary to find a way to document such large area with low-cost drones in about 10 days. As previously reported, with accurate planning beforehand the archaeocopter team was able to document 13 desert fortresses in Bukhara/Uzbekistan in 2015 in only 5 days. During the preliminary stages, all flights and a potential parallelization of operations which are executed by several teams need to be elaborated. The main challenges are the coordination of the teams and flights in an area without internet and visual markers, which would facilitate the orientation in the field. Also, a sufficient but not too large overlapping of different flight sectors is necessary. The planning part beforehand took several months and this paper presents findings and solutions as guidance for further documentations of such huge areas which do not have a well-developed infrastructure. This paper starts with the calculations and considerations of test flights in the preparatory phase. After presenting the results of this campaign the validity, robustness and scalability of these results for large-scale documentations will be discussed.

Alessandro CAMIZ | Zarif EZDEŞİR | Monica BERCIGLI, Italy

UAV photogrammetry of large fortifications with low cost tools a Cyprus experience

Keywords: IUAV, Drone, DJI Spark, low cost solutions, aerial photogrammetry

Abstract: Is it possible to take the survey of very large Castles using an off-the-shelf very entry level UAV, it is possible to consider a “selfie” drone as a real tool for capturing a good level 3D model of a whole fortress? In this case study, based on the survey of the Kyrenia Castle in Girne, North Cyprus, the use of a DJI Spark IUAV unit, mounting its standard camera, was the test tool for the shooting of a 150x150 meters large fortification. The post processing of the data was aimed to produce a well working massive model, then integrated by ground level photography to complete a usable textured model of all the walled structure. Some specific treatments were needed to enhance the data coming from the IUAV unit, operating both on the quality of the images and the GPS data inside the EXIF information. With a certain patience and some tentative, this simple tool turned out to be a credible solution in front of such complex architecture. Creating a model with an acceptable quality for documentation and multimedia uses. The treatment of the data and the following photogrammetry process was operated using multiple SfM software, comparing the results to understand specific issues of the specific solutions. In this contribution to the round table, all the procedures adopted in this case study will be presented and described, sharing the experience and the final results, discussing issues and problem solved.

Relevance for the conference: Facing the task of the survey of a gigantic castle with a very small drone

Relevance for the session: Complete description of the workflow, troubles, and troubleshooting for sharing the experience

Innovation: Use of very low cost solutions patching data contents to enhance the final results

References:

- Videoclip about the survey operations <https://youtu.be/XiN4Xi2F2rw> | Hill, G. (1948). A History of Cyprus. Volume 2: The Frankish Period 1192-1432. Cambridge: Cambridge University Press

Paolo FORMAGLINI | Filippo GIANANTI | Stéphane GIRAUDEAU | Alessandro GIACOMELLI, Italy

Five years of experiences of the Architectural Photographic Laboratory (LFA) in Florence, Italy

Keywords: Photogrammetry, structure from motion, photography, architecture, laboratory

Abstract: In the past five years, the Architectural Photographic Laboratory in Florence, part of the DIDALABS System of the Dipartimento di Architettura of the local University, has operated a large number of interventions in photogrammetry, basing on Structure from Motion procedures various intervention on small, medium size and even enormous architectures. The survey activities were brought on using a wide range of cameras, from compact point and shoot solutions to massive highly professional - high resolution DSLR, exploiting and/or resolving any kind of lighting and material, shapes, accessibility problems. Most of the survey were operated using terrestrial operations, thus in the recent years, the lab start processing IUAV and other aerial shootings. The proposed contribution will take care about presenting a set of significant interventions, exploring the main issues, the troubleshooting, the lessons learned in the will of discussing and sharing experiences about digital photogrammetry and enhancing the procedures. A particular attention will be paid to the shooting procedures, but also to the calculation settings, with a comparison between the single computer processing and the network calculation operated by the lab. In between the main subjects: the Façades of the Florence Cathedral, various towers from the Italian coasts, various square floors from the italian downtowns, sculptures from the Bargello Museum in Florence and other items rich of artistic and historical value.

Relevance for the conference: A significant set of experiences based on five years of activities

Relevance for the session: Various photogrammetric works approached in very different conditions and presented with the will of sharing and discussing

Innovation: Bringing the photogrammetric work to perfection is a never ending task, but someone must do it

References:

- Laboratory website in UNIFI (ITALIAN) - <https://www.dida.unifi.it/vp-204-laboratorio-fotografico-di-architettura.html> !

Fanet GÖTTLICH, Germany

New Insights on fast 3D - pottery in field documentation

Keywords: pottery fragments 3D-documentation structure-from-motion low-cost

Abstract: As part of a ceramics study of Iron Age amphorae from the site of Tell el-Burak (southern Lebanon), it will be tested how three-dimensional recordings of the ceramic fragments can be included in their documentation and analysis. This pilot project aims at increasing the available data and therefore to improve the analytical procedures by adding 3D data. These data are objectively recorded, can be used non-invasively, can be shared worldwide and build a basis for reconstructions. The calculated 3D model represents the entire sherd and finally the original find must remain in the country of origin.

For foreign campaigns an uncomplicated, effective and cost-effective solution is important. Thus, only a (semi-) serial and therefore fast and, above all, economic method meets the demands of documentation procedures abroad.

During the campaign 2018, a trial setup was tested and several studies were conducted on the best recording technique. Subsequently, the parameters for the most successful processing path were tested and determined.

The objective was initially based on the results of conventional ceramic documentation. The use of a high-precision white-light-scanner had to be ruled out for financial as well as organizational reasons. Thereby, the method structure from motion was chosen for the three-dimensional documentation. For maximum resolution and accuracy, many parameters of the method have been evaluated and adapted. In addition, the setup of the measuring station was optimized in several areas for this particular object category.

Common Software was used for processing the data. Again, the processing workflow has been adapted for effective use as well as the acquisition workflow.

This project is made possible by the cooperation of Johannes Gutenberg University Mainz (Dr. Aaron Schmitt) and the center for digital cultural heritage in museums (ZEDIKUM) - Staatliche Museen zu Berlin.

Relevance for the conference: archaeological finds are 3D recorded quickly, objectively and serial, can be used non-invasively and shared worldwide

Relevance for the session: the digitization is done by an image-based method (prepared SfM) and the manifold results, which are primarily used for documentation, can also be extended as desired for 3D applications

Innovation: low-cost, serial acquisition method with coherent workflow to a scaled, documentary image with additional benefits in 3D

References:

- Kempel M., Sablatnig R. (2006) 3D Data Retrieval of Archaeological Pottery. In: Zha H., Pan Z., Thwaites H., Addison A.C., Forte M. (eds) Interactive Technologies and Sociotechnical Systems. VSMM 2006. Lecture Notes in Computer Science, vol 4270. Springer, Berlin, Heidelberg;

- Barreau, Jean-Baptiste & Nicolas, Théophile & Bruniaux, Guillaume & Petit, Emilien & Petit, Quentin & Bernard, Yann & Gaugne, Ronan & Gouranton, Valérie. (2014). *Ceramics Fragments Digitization by Photogrammetry, Reconstructions and Applications*. International Conference on Cultural Heritage.

Henry-Louis GUILLAUME | Arnaud SCHENKEL, Belgium

Photogrammetry of cast collection, technical and analytical methodology of a digital rebirth

Keywords: Photogrammetry, Plasters Collection, Monocular Delighting, Complete Workflow

Abstract: Before the use of photography and digital projections, cast collections had a major place in Archaeology and History of Art studies. Replacing the original content, they permitted in different manners to touch the past in a safety and unobtrusive way : watch, touch and manipulate the cast allowed proactively students to learn the techniques of the ancient masters.

Nowadays cast collections lays in university corridors or in museum storage waiting to be restored due to their material properties, the degradations of time, and the difficulty to use them in a course.

Thinking about their past didactic roles, the Université Libre de Bruxelles wanted primarily a way to restore and preserve her antique study cast collection and, in the same way, give it a new sight as a nowadays collection study.

For three months, in the same time of cast restorations, PANORAMA team have developed a photogrammetric workflow to produce and treat photographic shooting, texture delighting, point clouds reconstruction, meshing, retouching, simplifying, retopologing, relighting and at the end of the whole process, web publishing.

Through this paper, we want to introduce our photogrammetric reconstruction methodology and particularly our texture delighting process developed in our multidisciplinary platform to enhance texture details and easily reintegrate models as a fully usable 3D asset in any 3D scene.

Target group: archaeology, interdisciplinarity, museum, university, 3D, photogrammetry, scanner,...

Relevance for the conference: Reconstruct the past of a didactical collection through photogrammetry

Relevance for the session: Reusability of a didactical tools with new technology

Innovation: A complete real to digital workflow with a consistent monocular delighting to produce 3D assets

Sofia MENCONERO | Martina ATTENNI | Marika GRIFFO | Almira KHAFIZOVA, Italy

A workflow for fast 3D documentation: an experience on medieval architectural fragments

Keywords: SfM; 3D documentation; Kyrenia castle; medieval fragments.

Abstract: Nowadays, the knowledge of archaeological and cultural heritage artefacts is asking for the use of 3D model. Innovative tools constantly developed make it possible for the scholars to adopt an integrative approach accessible by everyone involved in the whole process of archaeological and cultural heritage surveying and representation.

The topic here discussed aims to investigate a workflow that allows a non-expert user to produce and manage a Structure from Motion 3D model, considering all the parameters that concern the reliability of the model and its scale. The proposed workflow regards the object scale going from 20 up to 60

centimetres in architectural heritage field. Several examples will be presented to give a general frame of the possible results obtained by following a step by step procedure; the latter has been developed on several fragments now located in the Kyrenia Castle and surveyed during the international workshop "Reading and designing Kyrenia Castle" that was held in Cyprus. The final purpose is to identify a standard that goes from data acquisition to the 2D/3D models' production and furthermore that can be adopted in the following conditions: when the whole process must be conducted in just few days, only entry level tools are available, beginner operators might perform data acquisition and elaboration and the survey operations involve a big number of objects. A further development of this strategy could be to provide a fast 3D documentation shared and available through a database for archaeological excavations. Attention has been focused on the advantages, costs, and precision levels guaranteed by SfM, as well as 3D digital model as the fundamental element of the archaeological studies.

Relevance for the conference: A contribution about consolidation and well eradicated procedures in the context of teaching methods and documenting.

Relevance for the session: A contribution that tries to put in order procedures and methods for teaching and documenting architectural fragments.

Innovation: Development of specific workflows for didactic that allow to control procedure suitable for specific results.

References:

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- Cefalu A., Abdel-Wahab M., Peter M., Wenzel K., Fritsch D., Image based 3D Reconstruction in Cultural Heritage Preservation, in *Proceedings of the 10th International Conference on Informatics in Control, Automation and Robotics*, 2013, pp. 201-205. DOI: 10.5220/0004475302010205.

Panagiotis PARTHENIOS, Greece

Combining Indoor Positioning Systems (IPS) with SfM 3D Point Clouds in Cultural Heritage

Keywords: Indoor Positioning Systems, Structure from Motion, Point Clouds, Cultural Heritage

Abstract: The benefits of using Geographic Information Systems in archaeology and cultural heritage are undeniable and the use of spatial data has been crucial in shaping a wide number of research fields. Nevertheless, the transition from Geographic Information Systems (GIS) to Indoor Positioning Systems (IPS) has not been adequately studied, despite the very promising uses of IPS in cultural heritage. This paper describes research conducted at the Digital Media Lab, Technical University of Crete. The use of an Indoor Positioning System (IPS) is being tested on a monument in Crete, Greece, in combination with a 3D Point Cloud produced with Structure from Motion Techniques. The selected monument under study is located on the seafront of the 700 years old Venetian harbor of Chania and it used to be the private residence of Ambassador R. Krueger who built it on 1890. The goal is to examine whether 2D data produced by IPS can be enhanced with 3D data from SfM in order

to provide an enriched experience of navigation and personalized services customized to each user's needs. Moreover valuable insights for improving the architectural configuration of the monument's interior can be extracted by documenting the exact position of each user in space in real time.

Software used are Indoor Atlas for IPS and Capturing Reality for SfM.

Relevance for the conference: This study combines Structure from Motion techniques for acquiring 3D models, with Indoor Positioning Systems for navigation in monuments.

Relevance for the session: This study takes GIS in the interior of monuments and tries to combine it with 3D Point Clouds

Innovation: The innovation of the study lies on the effort to combine affordable IPS (without using any hardware sensors) with SfM.

References:

- Sanna Kaasalainen, Simo Gröhn, and Laura Ruotsalainen, "Work in Progress: Combining Indoor Positioning and 3D Point Clouds from Multispectral Lidar", 2016.
- <http://www.indooratlas.com/2017/09/11/citynomadi-creates-location-aware-experience-for-moomin-museum-visitors/>

Giorgio VERDIANI | Stefano BERTOCCI | Muge SEVKETOGLU, Italy

Graffiti photogrammetry, extracting the signs from the walls of the Kyrenia Castle

Keywords: Graffiti, Photogrammetry, 3D model, multimedia, museum

Abstract: Contemporary photogrammetry, with the use of high resolution sensors and correct shooting procedures, allows to get details far from the common level of perception of the human eye. This can be particularly useful in the use of macro and micro details, but it can be extremely useful also in specific situations, when even quite large elements are difficult to be read and interpreted. Is this the case of the walls with Graffiti in the Kyrenia Castle, North Cyprus, where a set of representations showing ancient ports, harbours, ships and boats are extremely difficult to be read in the actual lighting situation. This is also a case study where the lighting situation is not ideal and where some logistic issues have caused the missing of a proper portable set of lights. Thus, with specific solutions, taking care about the shooting technique using state of the art camera and lens (Nikon D800e and 60mm F2.8 Micro Nikkor), it was possible to take a well detailed set of images to be used in the creation of an ultra-detailed 3D model of a whole set of graffiti. From this, using 3D rendering and multimedia techniques a set of proper elements has been created for dissemination and teaching purposes, allowing to enhance the perception of these artworks in the waiting for a new and more advanced permanent lighting system. The presentation will bring all the technical data from this case study, the detailed description of the lesson learned, suggestions about how to enhance the results from such a survey campaign and the complete workflow from shooting to multimedia creation/exhibition.

Relevance for the conference: An interesting subject expanding the micro-photogrammetry to the scale of the architectural part

Relevance for the session: Description of the workflow, sharing of an experience that can be replied in other context

Innovation: Expanding to medium scale and to multimedia presentation the techniques of micro-photogrammetry

References:

- Videoclip about the operations: <https://youtu.be/Yqw1ZrdWH1A> | Katzev, M. (1969). The Kyrenia Shipwreck, Expedition, 11

Colin WALLACE, Canada

Alchemy: A pathway to 3D reconstruction of past images

Keywords: Retrospective Photogrammetry, 3D archaeology, Legacy data

Abstract: Retrospective photogrammetric 3D modeling of archaeological sites and monuments using archival photographs has achieved encouraging results as its possibilities and limitations are addressed. I will discuss the limitations posed by both the archiving processes and the use of photogrammetric software with regard to camera calibrations. By eliminating elements that reduce the quality of the modeling, I will show what is involved in achieving maximum detail and accuracy. By the time they become available in a database or online, archival photographs have gone through several steps in processing; each of which diminishes the quality of the final photographs and their ability to be compatible with each other. Based on retrospective photogrammetric projects undertaken in spring/summer 2018 I will demonstrate how archival photographs can be brought to a level that allows them to perform in the same manner as a contemporary equivalent. Using archival photographs of the American School of Classical Studies in Athens, I am reconstructing archaeological sites in the Athenian Agora (Omega house, the State Prison and the Royal Stoa) and in Ancient Corinth (Peirene Fountain, Fountain of the lamps and East Stoa) in order to aid in preservation and assess deterioration. With this goal in mind the accuracy of the 3D modeling is paramount and requires novel approaches to their improvement.

Relevance for the conference: The techniques that I will present allow us to reactivate and reconstruct three dimensionally from previously researched records.

Relevance for the session: My research focuses entirely on using images from the past to recreate and repurpose them in the present

References:

- Wallace, C. (2017). Retrospective Photogrammetry in Greek Archaeology. *Studies in Digital Heritage*, 1(2), 607-626.
- <https://doi.org/https://doi.org/10.14434/sdh.v1i2.23251>
@inproceedings{Maiwald2017PhotogrammetricAO, title={Photogrammetric Analysis of Historical Image Repositories for Virtual Reconstruction in the Field of Digital Humanities}, author={Ferdinand Maiwald and T. Vietze and Dorothe Schneider and Frank Henze and Sander M{\u}nster and Florian Niebling}, year={2017} }

Cartographic Visualisation and Storytelling for Cultural heritage: Techniques and Methods

Chairs: Georg GARTNER | Markus JOBST, Austria

Recently, modern cartography have become more and more popular not only in traditional means, but also in new domains. The increasing use of modern cartography methods and tools as well as the growing ubiquity of cartographic technology in our daily life are significantly changing the way people interact and access cartographic models. They also bring further challenges, as well as some other methodological and technical issues. Research on these issues have been emerging in recent years. Lots of research efforts from both technical (e.g., computational) and non-technical (e.g., graphical, cognitive) perspectives have been paid to these issues, and result in many interesting findings.

Scope and novelty of the round table: This round table aims to provide a forum for these lines of research to meet and to discuss these cognitive, cartographical, methodological issues of cartographic visualisation and storytelling for cultural heritage, from both technical/computational and non-technical perspectives. The objective is to include “state of the art” research papers on these aspects, as well as to identify and formulate key research questions for further development of the field.

Francesco Porras Bernandez, Austria

The geospatial semantic web as foundation for knowledge networks of cultural heritage

Keywords: cartography, geospatial semantic web, knowledge networks, linked data

Abstract: The geospatial semantic web is an evolution of the semantic web in the spatial domain that aims to integrate geospatial information at the base of the semantic web. The main objective is to ease the integration and retrieval of spatial data. In order to represent geoinformation, it is required the construction of gazetteers and the development of spatial ontologies. The development and adoption of standards is fundamental for the evolution of the field, not only in the geo-domain but also in humanities.

Growing efforts in the development of cultural heritage knowledge networks can highly benefit from an intelligent referencing of cultural items within their geospatial framework (e.g. place of discovery). Items can be related between them and searched for in new ways based on complex semantic queries that could include spatial analysis involving topological relations. Recent advances point towards the representation of not only points, but also surfaces in linked data databases. We could envision a future of easy retrieving of knowledge and information from heterogeneous data sources of cultural heritage.

This presentation focuses on the geospatial extension of knowledge networks and highlights the importance of the geospatial semantic web. It adds to the principles of spatial data infrastructures and knowledge transfer in the world wide web.

Georg GARTNER | Markus JOBST, Austria

Cartographic Visualization and Storytelling

Keywords: cartography, communication, spatial presentation, stylized reality

Abstract: In this presentation it is argued, that maps are most efficient in enabling human users to understand complex situations and that this function becomes even more important in the realm of more and more sensors and respectively data being available. As maps can be understood in a modern sense as tools to order information by their spatial context they are interfaces between data and humans which several functions, such as enable human users to interact with data, to answer location-related questions, to support spatial behaviour, to enable spatial problem solving or simply to be able to become aware of space and to gain awareness and understanding the role of cartographic interfaces and visualisation techniques in context of newest media is crucial for all domains dealing with spatial data.

Modern Cartography can be characterized as a domain making use of ever more new modern technologies for all parts of the spatial data handling processes, including data acquisition (e.g. UAVs currently), data modelling (e.g. service-oriented architectures, cloud computing), data visualisation and dissemination (e.g. Location-based Services, augmented-reality). In this context maps have become not only visual instruments but also tools for interaction and synchronisation of knowledge.

Nicole HIGH-STESKAL, Austria

Celsus

Keywords: archaeology, digitization, text encoding, linked open data

Abstract: CELSUS is an archaeological digitization project focused on the creation of a spatially driven digital edition of the monograph series *Forschungen in Ephesos (FiE)*, a publication series edited by the Austrian Archaeological Institute (OeAI). It was first started in 1906 and represents the most important results of the Austrian excavations in Ephesos to date.

In keeping with the tradition of the *FiE*, the topographical approach will be retained and geo-spatial data will play an important role in linking texts across volumes and also to gazetteers. The monuments of Ephesos have not yet been marked on many of the openly accessible gazetteers. Part of the project will involve mapping our detailed GIS data of Ephesos to these gazetteers along with the creation of an ontology of the names used to refer to these places in German as well as in English and Turkish. The aim is to facilitate research by encouraging users to move between the texts and map interface in order to explore the full history and research history of a single place. Furthermore, the discoverability of the research will be enhanced by multi-lingual query capabilities of the standardized and harmonized toponym gazetteers.

This project makes use of knowledge networks and spatial data infrastructures. It extends the previous developments with a cartographic perspective that intends to enhance geospatial relations and the thematic information of *FiE*.

Markus JOBST, Austria

Spatial data infrastructures and core datasets

Keywords: SDI, core data, data integration, cultural heritage requirements

Abstract: In cultural heritage a diversity of documents and data are collected. Documents span from excavation diaries to published scientific papers and books for a wide public. Data recordings span from technical drawings, measurements, surveying methodologies to different photogrammetric and even remote sensing recordings. All those documenting parts play their role in the cultural historic puzzle and deliver important information of actual knowledge. Therefore these parts have to be available for fast evaluation. In addition all collected information and maps need to be digitally findable, accessible and prepared for further use. Heritage scientists have the requirement to refer to this various information sources and rework the outcomes. New insights can be achieved even by an digital of digitally supported workflow.

Spatial Data Infrastructures (SDI) and its technological components provide a framework to make information sources findable and reusable. It establishes decentral data integration. Data integration itself calls for a definition of core data, the basic topographic building blocks, which are used to geo- and time-reference thematic (as well as heritage) datasets. The main IT principle which allows to share information without copying the data, is a service-oriented architecture. Its most important building block are metadata, which should be standardized for global distribution and the foundation of knowledge networks.

This contribution introduces into the main components of SDI, discussed core datasets and evaluates the main requirements for cultural heritage data.

From field to screen – Digital technologies in rescue archaeology

Chairs: Nadine ALPINO, Germany | Ute SCHOLZ, Austria

Rescue archaeology is a main factor in generating and recording archaeological data which will be transformed afterwards by scholars and visualizers. Using digital technologies can help organize, structure and manage archaeological data right at the excavation site and provide powerful tools to save time and money. It's the moment when you generate important data which are necessary for a following digital analysis for example with GIS or for visualizing a reconstruction. Many possibilities are given, but are they like a matter of course in use everywhere at a rescue excavation site?

If the answer is 'yes' let us talk about what we could improve. If the answer is 'not at all', that there is still an imbalance between an already self-evident use and a slow-going approach, let us talk about the reasons. Is there a lack of information? No time and money for further education, workshops, and courses? No money for unaffordable software? Maybe a mixture of everything?

We would like to invite you for an exchange of experience and discuss working situations in different countries:

- What have been the preconditions for an already successful use?

- How can experience and skills in using digital methods (like digital surveying, data management, drawing, modelling, photogrammetry, SfM...) be improved in a rescue archaeology context?
- What could be improved to get better results and spend the (often) short time at the excavation site more efficiently?
- How can skills be trained in a rescue archaeology context?
- Could specific trainings fitted for archaeological requirements be worked out by hard- and software developers and archaeologists?

David BIBBY, Germany

CAD to Open Source GIS with Survey2GIS: The Paradigm Shift in Digital Excavation Documentation at the State Heritage Department in Baden-Württemberg, Germany

Keywords: Paradigm Shift, GIS, Survey, Topological Integrity, Open Source

Abstract: Until the mid 1990s excavations were recorded by pencil on millimeter paper. After that the pencil was replaced by the totalstation, paper by the computer and CAD. This development was, metally, simply a 1:1 digitalisation of the analogue process. Visual recording and the collection of descriptive information remained separate processes.

The real paradigm shift didn't happen until a decade and a half later. There were a number of reasons. Fundamental though was the increasing realisation that geographic information systems offer more appropriate tools for excavation recording than CAD. On excavations we uncover contexts, features, finds and so on. They possess not only geometric form but also substance, structure, color and matter etc. GIS is better able to handle this combined geometric/factual information than CAD.

In taking this step the State Heritage Department decided to develop its own software to handle field data and, together with vigerous FOSS partners, make the software freely available in order to 1) avoid the constraints, restrictions and not least the costs of proprietary software and importantly, 2) to promote "research driven development". It was possible to call upon much internal and external experience – both practical and theoretical – to conceive and produce bespoke software which adapts to the work in hand rather than the other way round.

The result is "Survey2GIS", a light-weight tool for processing surveying data into any GIS system, both as a plugin for gvSIG-CE and standalone. The process is fully steerable, allowing flexible adaptation to individual survey workflows and data structures. During the development, high priority has been given to Survey2GIS' ability to generate topologically correct and fully attributed output. Survey2GIS can be used as a GUI or as powerful, iterative, command-line application to produce fully structured geodata from any field data for any project. Survey2GIS has now reached the mature version 1.5.*

Relevance for the conference: The thought processes of a large State department in taking the step from CAD to GIS are revealed and it is shown how FOSS can help this process and result in a powerful, user friendly tool.

Relevance for the session: The thought processes of a large State department in taking the step from CAD to GIS are revealed and it is shown how FOSS can help this process and result in a powerful, user friendly tool.

Innovation: Survey2GIS is now well developed and the only widely distributed fully functional, completely free tool of its type - it must be of interest for international colleagues.

References:

- <http://intarch.ac.uk/journal/issue43/3/index.html>
- https://feldarchaeologie.de/wordpress/wp-content/uploads/2017/07/Publ_News_11.pdf

Reiner GÖLDNER | David BIBBY, Germany

Digital Excavation Documentation – Objective and Sustainable (A Workshop Summary)

Keywords: digital excavation documentation, digital archiving

Abstract: On archaeological excavations context information cannot be preserved in its original state. So it is important to build an objective and sustainable documentation which will provide all information gathered for future scientific visualisation. Some interesting aspects arise from combining the questions: Which digital methods best produce objective record of excavation facts and which of them produce sustainable information ready to be preserved over hundreds of years.

Within this subject area the workshop covered questions such as: Which digital methods are used for excavation documentation? Is there a trend from CAD to GIS? How useful are 3D scans? How might we achieve data sustainability? How can usability be preserved over hundreds of years? Which open standards are useful?

Today's practice often shows that digital methods are considered independent of preservation aspects. This workshop was a step toward changing this and setting up synergy effects combining both themes. It offered the possibility of exchanging hands-on experiences between archaeologists on the one hand and discussing prospects and starting points to future FOSS projects on the other hand. The presentation will give a short summary of the workshop „Digitale Grabungsdokumentation – objektiv und nachhaltig“, which was held in February 2018 in Dresden. The Workshop was organized by the commission Archaeology and Information Systems of the Association of State Archaeologists in Germany due to increasing interest in sharing experiences on this topic. About one hundred archaeologists and excavation technicians from Germany and Switzerland came together, shared their experience, presented their ideas and discussed the above mentioned aspects.

Relevance for the conference: The presentation is about objective and sustainable digitisation as precondition for scientific visualisation.

Relevance for the session: Rescue archaeology is the central use case of all discussed digitisation and archiving aspects.

Innovation: The aim is to set up synergy effects combining questions of digitisation and archiving.

References:

- <http://www.landesarchaeologen.de/verband/kommissionen/archaeologie-und-informationssysteme/projektarbeitsgruppen/workshop-digitale-grabungsdokumentation/>

Rob van HAARLEM | Egbert GRIFFIOEN, The Netherlands

A new way to excavate

Keywords: GIS mapping documentation innovation

Abstract: Most work related to an archaeological excavation comes after the excavation itself. All the data needs to be digitized, categorized and connected to the database. If something went wrong there isn't a chance to go back in the field and excavate the location for a second time. This makes it of great importance that everything is properly documented. Most methods however don't have the possibility to work in a GIS environment at the dig site. This creates a risk for the quality of the data. It is possible to combine a GIS environment with the excavation data directly in the field. By using a map viewer that has a drawable layer combined with a field computer connected to a GPS or RTS all geometry's will be visible in the field. Within the map viewer it should be able to add the data. By creating a database structure your GIS environment is completed during the excavation.

Thanks to the direct link between geometry and data, all geo-objects as described in the KNA 4.0 (Dutch quality norm for archaeology) can immediately be manufactured directly in the field. Because documentation have already been digitized in the field without additional steps being required. The result should provide a clear documentation and a time saving in the elaboration of the excavation documentation.

Besides that the software is a new way to gather information in the field, it can also be used as a tool for public outreach. Maps can be published and shared with everyone even during the excavation.

Also it will be possible to add 3D models and data to your map.

Tijdlab is a company from the Netherlands specialized in 3D techniques. Together with MapGear, a company specialised in GIS, they are developing GIS software for the documentation and presentation of archaeological sites.

Relevance for the conference: The software is a complete new way to documentate archaeological excavations. It combines also GIS and 3D models

Relevance for the session: It's a new way to use GIS

Innovation: A complete new way to documentate archaeological excavations

Open Data, Public Science, and Global Digital Heritage

Chairs: Victor Manuel LOPEZ-MENCHERO BENICHO, Spain | Herbert D. G. MASCHNER, USA

Digital cultural heritage requires a two-part approach. First, the accurate and scientifically valid documentation of cultural heritage monuments and artifacts requires an integration of geospatial techniques, visualization, virtualization, and computer modeling with archaeology, art, and architecture. This necessitates both broad and specialized training of practitioners and creates, by default, a multi-disciplinary approach. Second, making these data useful, and making data and results available to the public is essential. This requires access to long-term digital storage and curation, easily managed databases, and the support of local and regional administrations. The public owns its

cultural heritage. Public funding sponsors our work and we owe our citizens access to the results of their taxation.

Over the last three years more than 70 sites, monuments, buildings, and museums have been digitally documented in Spain, France, and Italy by members of the Global Digital Heritage team. Using terrestrial and UAV photogrammetry, high resolution laser scanners, and airborne LiDAR, we have collected over 40 terabytes of data and produced an extensive suite of outputs. Spanning the Paleolithic to the 19th Century, and including everything from Roman dams to fortifications, churches, public plazas, caves, rock art, museums, and bull rings, this project includes nearly every type of data and acquisition technique required for the modern documentation of cultural heritage. This round-table presentation and discussion will highlight the successes of recent work documenting cultural heritage and our efforts to make the data scientifically useful and publically available.

Laurent COSTA, France | J. Bart MCLEOD | Jeffrey P. Du VERNAY | Herbert D. G. MASCHNER, USA | Victor Manuel LOPEZ-MENCHERO BENDICHO, Spain

GIS and geospatial databases for the presentation and management of 3D data

Keywords: GIS, 3D, Geohistorical databases, web mapping, georeferenced history

Abstract: Acquisition techniques have changed significantly over the last ten years. Digitization has continued to develop at all scales (from the object to the territory) and for all types of sites (from ancient prehistory to the modern period). They have made it possible both to multiply the angles of measurement of archaeological and heritage reality and to make available to researchers new multimodal collections of studies that are becoming the new infrastructure of research.

But while the technical evolution of recent years remains spectacular, it is nevertheless true that the conceptual and technical links to the use of these new objects of knowledge are not all solved. In a context where the Internet has become the essential development tool, the question of interfaces that make it possible to combine heterogeneous approaches and data within the same management system is crucial. Space can then be seen as a primary entry point to facilitate access to these knowledge bases and the development of web mapping can allow multi-scale repositories to be built in shared access.

Several multimodal platform experiments have been developed by different communities, notably archaeologists in Europe and elsewhere (ArcheoFab, ArkeoGIS, Chronocarto, Ariadne, Zamani project, for example). These infrastructures raise many concrete questions: those of access to research data for researchers and civil society, those of the structuring of these groups, those of their governance and finally those of the interfaces for making them available. Here we examine the state of various practices associated with these tools and propose, through concrete examples, initiatives designed to promote the sharing of knowledge and data acquired.

Relevance for the conference: The integration of GIS, 3D data, and web structures for serving those data is of paramount importance to visualization and digital heritage.

Relevance for the session: Creating appropriate web interfaces that manage all scales of digital spatial data, from the artifact to the landscape, is critical to the mission of the project.

Innovation: We create a new initiative for the integration of different forms of spatial data and their web presentation, with concrete examples.

References:

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Jeffrey Du VERNAY | Aurelia LUREAU | J. Bart MCLEOD | Victor Manuel LOPEZ-MENCHERO BENDICHO | Gabriel WICK, USA

Virtual tours and the impact of 360° imagery on local communities: heritage and the archaeology of place

Keywords: Virtual Tours, 360° Imagery, Cultural Heritage

Abstract: The creation of virtual tours of cultural heritage sites represents an interactive and engaging way for archaeologists, local communities, and the broader public to experience archaeological sites from afar, including those with limited or restricted public access. There are many avenues that are possible for the creation of digital virtual tours that derive from various datasets including point clouds, 3D models, and 360° imagery. Over the past year, Global Digital Heritage (GDH) has captured over one thousand 360° images (as well as an extensive amount of 3D data) at cultural heritage sites located in Spain, France, and the United States for the purpose of generating virtual tours for research, education, and wider public use. This paper details our virtual tour making efforts and explores the impact that these virtual tours can have on local communities and within cultural heritage sector more generally. The paper includes a short discussion of our image capturing workflow, processing, and general mechanics of virtual tour generation. Additionally, the various types of content incorporated into our virtual tours is discussed, including 3D models, animations, videos, historical imagery and information, and other materials, and ways such additional content serves to enrich and enhance the virtual tour experience. These points will be illustrated in the paper using various virtual tour case studies created by GDH. It is concluded that virtual tours of cultural heritage sites using 360° imagery can be an ideal way to virtually bring people to archaeological sites because of the broader familiarity 360° imagery has within the general public over other types of virtual data. Additionally, it is concluded that such tours are a perfect way to integrate and present the various datasets and information collected by GDH.

Relevance for the conference: The paper is relevant to the conference because it explores the use of visual data (i.e., 360° imagery) within the cultural heritage sector and beyond.

Relevance for the session: The paper is relevant to the session because of its focus cultural heritage, 360° imagery, and the virtual experience of archaeological sites.

Innovation: The paper's innovative component includes broad- scale integration of various types of datasets into the virtual tour experience with a focus on local communities, general public, and researchers.

References:

- Design and creation of a 3D virtual tour of the world heritage site of Petra, Jordan, Stephen Wessels, Heinz Ruther, Roshan Bhurtha, Ralph Schroeder, Proceedings of the AfricaGeo Conference, 2014.
- Documentation of Historical Buildings Via Virtual Tour: The Complex Building of Baths in Stratsbourg, M. Koehl, A. Schneider, E. Fritsch, A. Rachedi, S. Guillemain. International Archives of the Photogrammetry, Remote Sensing, and Spatial Informational Sciences, Volume XL-5/W2, 2013.

Miguel Ángel HERVÁS HERRERA | Jeffrey P. Du VERNAY | Victor Manuel LOPEZ-MENCHERO BENDICHO, Spain

Case study of Calatrava La Vieja and the comparison of traditional documentation techniques with 3D methods.

Keywords: Calatrava la Vieja, 3D documentation, 3D graffiti, Methods comparison

Abstract: The enclave of Calatrava la Vieja (Carrión de Calatrava, Ciudad Real, Spain) played a leading role in the settlement of the Alto Guadiana region for centuries, due in part to its strategic location next to one of the main fords of this stretch of the river, and its subsequent link to the road network that articulated the economic exploitation, the administrative structure and the military defense of the territory throughout its history. Inhabited since the Bronze Age, it housed successively an oppidum or walled city in the Iberian period, a small Roman settlement with continuity during the Visigoth period, the Islamic capital of the area for almost five centuries, a Templar fortress, and the founding convent of the military order of Calatrava. The archaeological research works began in Calatrava la Vieja in 1984, and has continued for 34 years. These works have allowed to discover, until now, more than half of the walled perimeter, the entire inside of the alcázar, and about 10% of the medina. Due to lack of technical and economic resources, until 2016 the research team of Calatrava la Vieja did the archaeological documentation of the discovered structures with traditional 2D drawing techniques. In July 2016 and September 2018, GDH and Baraka Arqueólogos did a complete documentation campaign using 3D methods (terrestrial laser scanners, drone photogrammetry, high resolution photogrammetry, 360° photography) with the intention of producing new highly detailed 2D and 3D representations of the entire site. This has allowed us to directly compare the results obtained with both methods, and analyze the advantages, disadvantages and limitations of each. The differences in documentation are best shown at both the macro-scale – the entire site, and the micro-scale – graffiti on a cistern (aljibe) prison. We show that 3D techniques are critical but require a multi-disciplinary approach.

Relevance for the conference: A comparison between traditional heritage and archaeological documentation techniques and digital documentation, especially 3D photogrammetry and laser scanning, demonstrates the effectiveness in regards to cost, time, speed, accuracy, and quality of data.

Relevance for the session: Calatrava la Vieja is a cornerstone project in the development of digital heritage documentation in Spain and demonstrates the role of both macro-scale documentation and micro-scale documentation in the creating of digital heritage.

Innovation: A direct quantitative comparison between traditional documentation techniques and digital techniques.

References:

- HERVÁS HERRERA, Miguel Ángel & RETUERCE VELASCO, Manuel (2014): “Calatrava la Vieja. Capital islámica de la región y cuna de la Orden”, en Alarcos y su contexto histórico. Actas de las IX Jornadas de Historia Local “Biblioteca Oretana”, I Jornadas de Historia Local de Ciudad Real (Ciudad Real, 22-24 de octubre de 2014), Ciudad Real, Ediciones C & G, 2014, pp. 235-282.
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Victor Manuel LOPEZ-MENCHERO BENDICHO | Herbert D. G. MASCHNER | Pierre-Yves GAGNIER | Laurent COSTA, Spain

Solving public, political, and administrative problems with 3D digital documentation.

Keywords: 3D, Cultural Heritage, Digital Heritage, Virtual Archaeology, Public Administration.

Abstract: In recent years it has become clear that the three-dimensional digitization of cultural heritage is helping to improve the current processes of research, conservation and dissemination of numerous monuments and sites. However, it is rarely discussed about the wide possibilities that this digitalization has to solve public, political, and administrative problems. The works developed by Global Digital Heritage in numerous monuments and archaeological sites in Spain and France have shown that the three-dimensional digitization of cultural heritage can influence the political, social and cultural sphere of a territory. This influence manifests itself through a set of transformations or changes in attitude on the part of both citizens and politicians, whose consequences are very diverse. Without any doubt, the immediate consequence and of greater transcendence that our work has had is that which has to do with the value that citizens and politicians give to heritage. Everyone knows that you cannot value what you do not know. The 3d digitalization makes the cultural heritage available to most people, including many monuments and sites that cannot be visited. In this way citizens can know their heritage and value it. It also allows to draw attention to the so-called emerging assets or new assets. These are assets that until very recent dates were not considered as part of the cultural heritage due to their lack of antiquity but nevertheless present a great historical interest. This has been the case of the Alhama de Murcia bunker (Murcia, Spain), a forgotten vestige of the defensive military architecture of the Spanish Civil War, and at the jails of the Ancient Régime of the towns of Picón and Villarrubia de los Ojos (Ciudad Real, Spain). A critical byproduct has been in education using virtual reality, and the creation of exhibits for the visually impaired using 3D prints.

Relevance for the conference: The creation of digital heritage assets that go beyond science, history, and documentation to the realms of public outreach, public administration, education, and accessibility is the key to the future of digital heritage.

Relevance for the session: Public access and global use of historical data has been the cornerstone of the Global Digital Heritage mission.

Innovation: This review demonstrates the concept of democratizing science, heritage, and cultural assets for use by all people.

References:

- Rizzo & A. Mignosa (Eds.), 2013. Handbook on the economics of cultural heritage. Cheltenham, England: Edward Elgar.
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Aurelia LUREAU | Jeffrey P. Du VERNAY | J. Bart MCLEOD | Herbert D. G. MASCHNER | Laurent COSTA | Gabriel WICK | Emmanuelle COLLADO, France

Digital documentation, restoration and conservation at the Château de La Roche-Guyon

Keywords: Digital documentation, digital collections, global 3D digitization, digitization workflow, global digitization management

Abstract: The Château de La Roche-Guyon, France, has a rich history. Occupied continuously from the IXth century onward, the site and landscape is a palimpsest of fortifications, buildings, tunnels, caves, trails, and passageways. Over 1000 years of attritional remodeling has resulted in a complex multi-faceted architecture and equally complex difficulties in conservation, restoration, and long-term heritage planning. More than seven weeks of digital documentation has been completed at the chateau by Global Digital Heritage in collaboration with researchers from the CNRS and the Université Paris1 Panthéon-Sorbonne and elsewhere in France, and in consultation with the EPCC Château de La Roche-Guyon (the public body charged with preserving and animating the site). Our focus was on three areas: digital documentation, maintenance and conservation planning, and digital public outreach. In this context, the rare but badly decayed mid-XVIIIth-century court theater, the early XIXth century neo-classical chapels and the medieval donjon have been digitized with future conservation and restoration projects in mind. The aim was to offer architects and conservators plans, sections and 3D models that would aid in assessing the current state of the buildings, and help guide future interventions. The castle is being digitized in 3D as a whole, but several smaller aspects like XIVth and XVIIIth-century sculptural bas-reliefs and graffiti from the early modern period and the Nazi occupation of the castle are being documented as well. We created hundreds of 360 panoramas in order to create virtual tours.

This project is being conducted with the cooperation of the family of La Rochefoucauld which still owns and lives in parts of the castle, and with scholars, historians, and writers through supplementary digital data, ancient maps, oral histories, folklore, and similar sources attributable to such a detailed and complex history as the Château de La Roche-Guyon.

Relevance for the conference: The global digitization of the site, and the smaller details, will be used as digital collections to be shared with the scientific community, but also the public worldwide.

Relevance for the session: This article explains the workflow and management of the digital data in a major French site in order to offer digital collections to the scientific community and curious citizens worldwide.

Innovation: Such a global digitization, paired with specific high-resolution details, in order to offer digital collections to the community, has not been attempted yet on such a difficult and complete site in France.

References:

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Herbert MASCHNER, USA | Victor Manuel LOPEZ-MENCHERO BENDICHO, Spain | Jeffrey P. Du VERNAY | J. Bart MCLEOD | Miguel Ángel HERVÁS HERRERA | Aurelia LUREAU | Myriam van WALSUM, USA

Global Digital Heritage – Mission, Goals, Future

Keywords: global heritage, virtual repository, democratization of science, digital heritage

Abstract: Global Digital Heritage (GDH) is a not-for-profit, private research and education organization dedicated to documenting, monitoring, and preserving our global cultural and natural heritage. We use digital visualization, 3D virtualization, geospatial informatics, and open access solutions to provide digital data and 3D models to governments, regional institutions, museums, local scholars, and the public. A key element of our mission is the democratization of science—we make all data freely available to the world in support of cultural heritage, heritage management, education, public access, scientific research, and to enhance the digital humanities.

We believe that many nations, local and regional museums, and universities have specific and spectacular places, monuments, and museum collections that are critical to the global scientific agenda. While these are often recognized for their heritage value, they are underutilized in science and research because of distance or because the scientific community does not know they exist.

We use virtualization technology to digitize entire collections, entire museums, and entire archaeological and paleontological landscapes. We make virtual repositories available to any student, any child, any scientist or any enthusiast anywhere in the world at any time. We create online analytical tools to democratize education and research through global analyses and exploration. Our virtual repository approach allows for the scientific analyses of places, monuments, and collections on a global scale, and provides a means to highlight the importance of those collections to their communities.

In the face of an increasingly hostile world, a global landscape where conflict and natural disaster are destroying our shared heritage at an accelerating rate, we provide 3D digital services to document and preserve places and specimens critical to our global heritage. We do this for free. We then return all of the data and results to the host institution or regional/local authorities.

Relevance for the conference: Global Digital Heritage and its projects are a model for the integration of data acquisition, public outreach, scientific validation, and global access to digital and visual data.

Relevance for the session: This is the lead paper in the session and outlines the methods, background, and justification for the various GH projects.

Innovation: The innovation is in the democratization of science – making all digital data freely available to the world.

References:

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Herbert MASCHNER | Victor Manuel LOPEZ-MENCHERO BENDICHO | Jeffrey P. Du VERNAY | J. Bart MCLEOD, USA

The presentation complex digital heritage data: 3D documentation and the democratization of science.

Keywords: virtual repository, democratization of science, digital heritage, database, 3D web interfaces

Abstract: Because of geography and distance, issues of ownership, restrictions on borrowing and transporting fragile museum collections, or problems of access to sites and monuments, or simply a lack of financial resources, there is a growing need in interdisciplinary and collaborative research pursuits to create multi-level, accessible, virtual repositories and scientific cyber-infrastructures that will allow researchers to access, integrate, and mine diverse collections, data assemblages, sites, monuments, and other remains at scales not currently possible within traditional research paradigms. Accessing data can often present aggregating problems to researchers in nearly every academic field of study, but this is especially acute for natural history and archaeological collections, and the lack of access has been a contributing factor in the absence of hard data comparability and an increasing reliance on the conclusions drawn by other researchers in resulting publications. We argue that the creation of virtual repositories housed in a comprehensive, hyper-plastic database system serving as virtual representations of archaeological assemblages, collections of sites and site features, or a museum's complete inventory, is critical to the future of modern analysis and the democratization of knowledge.

Global Digital Heritage and our suite of research initiatives is determined to make all of our data publically accessible and free to the public- but in such a form that research, analysis, and content creation can be done in a rigorous manor. This is a considerable challenge. Using 3D technologies, newly developed image-based database architectures, on-line measurement and analysis tools, and related methods of virtualization, enhance the scientific enterprise by bringing the archaeological world to any scientist, student, educator, or lay person, located anywhere in the world.

Relevance for the conference: The interrelationship between the creation of scientific data and making those data available to the public is critical to the modern research endeavor.

Relevance for the session: The democratization of science is a key element in the mission of Global Digital Heritage and its plans for a globally accessible archaeology and cultural heritage.

Innovation: Hyperplastic and fully-integrated databases that allow for online analysis and cross-disciplinary investigation.

References:

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J. Bart MCLEOD | Jeffrey P. DU VERNAY | Myriam van WALSUM | Aurelia LUREAU | Herbert MASCHNER | Victor Manuel LOPEZ-MENCHERO BENDICHO, USA

Workflow for photogrammetry and terrestrial laser scanning – data acquisition to Sketchfab

Keywords: laser scanning, photogrammetry, point-clouds, 3D modeling, 3D presentation

Abstract: At Global Digital Heritage, nearly 100 years of combined experience has created a workflow that has solved many of the problems of quality acquisition, data processing, visualization, and data access. But this is a dynamic process. Our methods integrate terrestrial and aerial photographs, terrestrial and aerial LiDAR, GIS, Google Earth, and other geospatial data and imagery. As new algorithms, software, hardware, and ideas are created, these are integrated into the workflow to create new opportunities for digital heritage and archaeology. These are then transformed into videos, virtual reality, architectural drawings, orthophotos, and virtual reconstructions. Lastly, these are served on the web as raw data, as research tools, as sources of scientific analysis, and as the art of archaeology and architecture. Here we provide a key example of this process.

In April of 2018, Global Digital Heritage (GDH) in partnership with Baraka Arqueólogos conducted a one-week digital documentation campaign at of the important heritage Paleolithic cave site, Cueva de los Casares, in Guadalajara, Spain. With more than 200 meters of accessible passages, this cave is widely recognized for containing some of the most important cave art in the country, including both engravings and paintings dating to over 20,000 years ago. It was also used Neolithic and Bronze Age farmers, and Islamic villagers, who built villages outside of the cave entrance and used the cave for storage and for sheltering their herds. Given the short period of time for the mission, the project goals were to map the cave system with terrestrial laser scanning, the surrounding cultural resources with drone photogrammetry, and document a representational sample of cave art using photogrammetry, reflectance transformation imaging, and high-resolution photography with the intention of producing new highly detailed 2D and 3D representations of the cave system and selected areas of art.

Relevance for the conference: The workflow described in this presentation can be used as a model for anyone attempting to use visual and digital technology in cultural heritage documentation and archaeology.

Relevance for the session: Description of the Global Digital Heritage workflow to capture, process, and disseminate geospatial data and imagery.

Innovation: Efficient data capture and processing model that allows geospatial data and high resolution imagery to be processed into a wide range of 2D and 3D content for research and public education and integrated into various online platforms for viewing and dissemination.

References:

- Federman, A., M. Santana Quintero, S. Kretz, J. Gregg, M. Lengies, C. Ouimet, and J. Laliberte. "UAV PHOTGRAMMETRIC WORKFLOWS: A BEST PRACTICE GUIDELINE." International Archives of the Photogrammetry, Remote Sensing & Spatial Information Sciences 42 (2017)
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Myriam van WALSUM | Pierre-Yves GAGNIER | Herbert D. G. MASCHNER | Jeffrey P. Du VERNAY | J. Bart MCLEOD | Aurelia LUREAU, The Netherlands

Natural History Collections as Cultural Heritage: Muséum national d'histoire naturelle à Paris.

Keywords: natural history; anatomical reference collection; interdisciplinary best practices

Abstract: Natural history collections are often overlooked as cultural heritage, but they have been part of our social environment for over 400 years: from cabinets of curiosities to the modern museum. Flora, fauna and geology were initially of interest mainly to elite hobbyists and scientists, but today have become a general social interest and these objects can now be considered as cultural heritage. Both cultural heritage and natural history research are based on physical objects which are curated in research and museum collections. Increasingly there is a need for unlocking the collections of either of these fields, for which databases, 2D and 3D imagery are essential. This overlap provides an excellent opportunity to share and develop best practices and solutions.

Over the course of 2016-2018 the team from Global Digital Heritage conducted 3D digitization projects at the Muséum national d'histoire naturelle (Paris, France). A high-resolution laser scanner was used in the vertebrate collections with the goal of making anatomical reference collections available to researchers and the public. TLS scanners and 360° imagery were used to document the entire exhibitions of the Galerie de paléontologie et d'anatomie comparée. This was undertaken in order to record the current exhibition layout with an eye on future restructuring and virtual visits, treating the historical gallery as heritage in itself. Photogrammetry was used experimentally on individual specimens and the content of the glass cabinets.

These data in turn are to be used in a suite of projects including remodeling the gallery for visitors and research efforts, documentation and presentation of rare or extinct species, the online development of scientific research opportunities, and basic scientific research. In this paper we describe the initial results of these digitization efforts and how they can be applied to cultural heritage.

Relevance for the conference: The creation of natural history collections is an aspect of cultural heritage, and there is a strong overlap of goals and methods in digitizing collections between cultural heritage and natural history.

Relevance for the session: The Global Digital Heritage team undertook digitization work at Muséum national d'histoire naturelle with the goal of collecting open data for public science and historical heritage.

Innovation: We stress the need to work together with natural history professionals because of the overlap between collections and research methodology, through which we seek to improve the best practices of both fields.

References:

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Smart ways of building up digital collections in libraries, archives and museums

Chairs: Anita EICHINGER | Christoph SONNLECHNER

In the last 20 years archives, libraries and museums have begun to digitize cultural heritage in order to preserve, but also to provide access to a wider range of users by the use of digital technologies. Every institution has its own “digital library/archive/museum” in which objects are presented in a more or less attractive way for users. What is very often missing is a user-friendly presentation as well as cooperations in order to reach a “smart” integration of the information systems (only to mention lack of responsive designs, lack of “single points of access” etc.). Moreover, cultural heritage institutions not only need to improve access for users, but also they need to strengthen cross fertilization between them and technological industries. There is need for common data exchange formats as well as for building up digitization strategies.

In this session we will focus on best practice projects in building up digital collections as well as enlarging and improving the visibility and accessibility of cultural heritage collections. Sustainable access to cultural heritage to a wider range of users through digital technologies can be labeled as “smart culture”. Therefore also papers are welcome which address (controversial) aspects on “smart city – smart culture”.

Klaus KEMPF, Germany

Smart digital collection building as an common task of archives, libraries and museums. The case of bavarikon

Keywords: bavarikon- digital collection building - intersectional collection building - data curation -

Abstract: Visibility, accessibility and contextualisation of content are the keywords of the digital age. Digital collection building is completely different of what libraries until the advent of the digital revolution, in particular of the upcoming of the internet have done. The specific characteristics of the digital objects their requirements in administration, usage and archiving need a complete rethinking of the traditional collection building principles. Collection building is not more the business of the individual library. In the field of the digital born and copy right protected publications nowadays we've the consortia which do in first line licencing, but more and more something like collective collection building. The creating of big collections by digitizing copy right free material needs a complete new approach what does mean, the collection building itself, but also or even in particular the presentation of the digital copies and their (re) contextualisation. Here we've to form an alliance of all the memory institutions, archives, libraries and museums. Now in the digital age we've the unique chance to overcome the splitting up of collections happened especially in the 19th century. The new technology allows the reconstruction of the traditional collections and/or to (re)create contexts between the different categories of digitized objects. Of course, we've to go also new ways what regards searchability and accessibility of the material. Its not enough to have a good digitisation technology, you need also an adequate, in particular userfriendly platform or portal to present in the best way the different objects and to invite the users to get on it. With new forms of presentation, like 3D-copies and virtual exhibitions the curiosity of the user will be stimulated and the attractiveness of the information offered will be augmented. With bavarikon made and run by the BSB we've a prototype of this new way of contextualised information presentation.

Wibke KOLBMANN, Switzerland

Strategy 2015-2020 – Joint efforts of the ETH Library with the natural history collections of ETH Zurich in digitalization

Keywords: business model, change management, cross-organizational cooperation

Abstract: Libraries are rethinking their business models given the changes in their environment due to digital transformation. The purpose of this paper is to discuss the digitalization of research collections and their integration in digital research infrastructures as a new field of activity within academic libraries based on challenges that ETH Library has experienced in current projects. Encouraged by an audit in 2011 by the ETH Board, the supreme governing body of ETH Zurich, the executive board of ETH Zurich decided in November 2014 on the "Strategy 2015 to 2020 for ETH Zurich's collections and archives". The strategy focuses on providing funding for the digital transformation of collections and archives, especially those of the departments and ETH Library is responsible for coordinating it. Due to ETH Library being ETH Zurich's competence center for digitization, metadata management, long-term archiving and innovative digital forms of presentation it is intended to combine the disciplinary know-how of the collection owners in the departments, with the information science know-how of ETH Library and to allocate the necessary resources within the library to ensure sustainability of services.

Together with the natural history collections – the herbaria, the entomological collection, the fungarium and the xylotheque, four digitization projects have been established. Furthermore, ETH Library seeks to implement and maintain a corporate digital infrastructure for the natural history collections of ETH Zurich including services for digital collections and digital asset management and a discovery portal. It will be presented what kind of measures were taken to enter a new phase of cross-organizational cooperation of the university library with the academia.

Relevance for the conference: Sustaining digital visual heritage is a challenging task in which academic libraries can support research by providing the necessary organizational and technical infrastructure.

Relevance for the session: Libraries can play an important role in the preservation and maintenance of project-financed digitization work.

Silvia RUSSEGGER | Austria

Documenting and informing - everything from a single source?!

Keywords: collaborative online cataloging, online representation, using synergies

Abstract: For many years, digital repositories have been created in libraries, archives, museums and archaeological sites. Much engagement and effort goes into cataloging and preserving cultural heritage in words and pictures. There is no end in sight.

It is becoming increasingly important to make the documented cultural heritage available to the public. Budgetary and personnel resource limits make it difficult for small and medium-sized houses to create attractive online catalogs to their collections. And yet, a lot of commitment and effort flows into the in-house representation of word and image.

One approach that is pursued in this context is to unite and share resources. For example, JOANNEUM RESEARCH has created a toolbox - digital.Culture - together with project partners, with which both the acquisition and the presentation in an online catalog can be accomplished without extra effort. The use of tools in a network facilitates working through the use of synergies and the learning of others. Nobody is a lone fighter anymore, you help each other.

For all the individuality needed to capture, the data for an online presentation will be presented in a consistent format and look, ensuring that the visitor receives exactly the information he wants - completely and immediately.

Using best-practice examples, the functioning of this approach is discussed with all its advantages and disadvantages.

Relevance for the conference: Cataloging is the basis for data representation, therefore, offering tools for matching both - cataloging and presenting - opens great changes for all cultural institutions.

Relevance for the session: The approach of collaborative working on digital collections is a smart possibility for using synergies and therefore, saves time for the most important tasks in a cultural institution.

Innovation: collaborative working on repositories and online catalogs offers new ways of preserving our cultural heritage.

WORKSHOPS

“GRAVITATE: Geometric Reconstruction And novel semantic reunification of cultural heritage objects”. Discovering relationships between artefacts using 3D and semantic data

Chairs: Chiara Eva CATALANO, I, Italy | Sorin HERMON, Cyprus

The potential of computer vision and computer graphics methodologies to support the research in Cultural Heritage (CH) has recently become more evident. Indeed, 3D modelling, processing and analysis are now mature enough to allow the management of 3D digitized objects as if they were physical, and then conducting specialised qualitative and quantitative analyses to assist researchers in the field. Moreover, knowledge technologies nowadays guarantee a digital and extensive documentation of many different aspects of complex assets as well as of contextual information about them. Bringing geometric and semantic modelling together is the next challenge towards a real digital heritage science.

The workshop aims to discuss the outcomes of the EU GRAVITATE project, where several tools for geometry-and semantics-driven analysis of digital artefacts has been realized and integrated to support research in archaeology. The general objective of the project is proposing an innovative approach to the study of heritage artefacts, which includes virtual reconstruction, classification and morphological analysis, steps that are currently limited by the access to physical items and the impossibility to re-unite them physically, either because they are stored in various museums or because physical refitting fails. The context is particularly interesting, as most of the archaeological objects discovered in a survey are usually fragmentary, eroded and broken, documented with traditional archaeological texts describing the content of the fragments verbally and therefore mostly qualitatively.

In the workshop, we will discuss the methodological approach and the results obtained in the project, covering both the semantic and geometric aspects. In particular, innovative techniques for semantic search and geometric similarity to re-unify and re-associate dispersed artefacts will be presented; once re-unification takes place, promising methods for the re-assembly of 2D and 3D pieces will be described; the GRAVITATE platform will be showcased, where the developed tools for the search, analysis and documentation of digital artefacts have been integrated. The workshop will include a final discussion with the audience on future research challenges.

Silvia BIASOTTI | Elia MOSCOSO THOMPSON | Michela SPAGNUOLO, Italy

Similarity reasoning over collections of 3D artifacts: the GRAVITATE example

Keywords: Geometric search engine, Similarity assessment, 3D models

Abstract: The creation of an increasing number of high-fidelity 3D models of objects and environments has opened new opportunities to study the past, by giving access to plenty of

representations of artefacts close to their original form. Besides their 3D geometry, objects are possibly equipped with photometric data, chemical properties and digitized card catalogue information on provenance, classification, and full-text archaeological descriptions from various sources.

In the GRAVITATE project, we are analysing to what extent existing similarity techniques are able to answer to the fragment similarity problem, discussing what is currently missing and what is necessary to be further developed. In this contribution, we present the criteria adopted for shape similarity reasoning and the solutions adopted in the current version of the geometric search engine of the GRAVITATE project. Since the concept of similarity is not unique, the geometric search engine takes in consideration multiple aspects of each model, mostly local (like color, thickness ...) but not only those (like its global shape), and can do searches keeping in count one or more aspects at once. The way these aspects, or properties, are encoded in the search engine and, based on these last, how models are considered similar are the two main challenges tackled in search engine design and dataset exploration.

Our aim is to develop a flexible and multi-modal reasoning able to support cross-correlation and searching across collections. Currently we are envisaging to drive similarity reasoning by the overall fragment size, thickness, material texture, shape continuity, colour, decorations and overall shape. First results are promising and a first prototype of the search engine is currently available.

Relevance for the conference: This paper overviews the mechanism behind the geometric search engine of the GRAVITATE project.

Relevance for the session: This paper overviews the mechanism behind the geometric search engine of the GRAVITATE project.

Innovation: We propose a new way of combining dissimilarity distances among collections of fragmented artefacts.

References:

- S Biasotti, B Falcidieno, D Giorgi, M Spagnuolo, 3D objects exploration: guidelines for future research, Eurographics Workshop on 3D Object Retrieval 2016
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Chiara Eva CATALANO | Silvia BIASOTTI | Andrea REPETTO | Michela SPAGNUOLO, Italy

Geometric characterization and semantic annotation of 3D artefacts

Keywords: Shape analysis; Annotation; 3D models

Abstract: Nowadays knowledge technologies guarantee a digital and extensive documentation of many different aspects of complex assets as well as of contextual information in very diverse fields, such as Cultural Heritage (CH). Furthermore, the potential of computer vision and computer graphics methodologies to support the research in CH has recently become more evident: 3D modelling, processing and analysis are now mature enough to allow the management of 3D digitized objects as if they were physical, and then conducting specialised qualitative and quantitative analyses to assist researchers in the field. Bringing geometric and semantic modelling together is the next challenge towards a real digital heritage science.

The talk will present the methodological approach adopted in GRAVITATE, covering both semantic

and geometric aspects. In particular, the computational techniques selected for the geometric characterisation of digital resources will be described. The set of properties refers to the physical aspect of fragments, such as shape, colour, or decorations, and aims at supporting the archaeological research with a quantitative approach.

On the semantic side, the part-based annotation of 3D cultural resources will be discussed, where controlled SKOS vocabularies, aligned and mapped to CIDOC CRM, have been defined to describe the properties and the relationships between the parts of the assets, and the overall context of the archaeological collections under investigation.

Relevance for the conference: The analysis and documentation of digital artefact perfectly fit the scope of Visual Heritage.

Relevance for the session: The integration of shape analysis techniques and knowledge technologies is one of the core objectives of GRAVITATE.

Innovation: The integration of shape analysis techniques and knowledge technologies allows a quantitative documentation of CH digital resources.

References:

- Torrente, M.L., Biasotti, S., and Falcidieno, B. (2018). Recognition of feature curves on 3D shapes using an algebraic approach to Hough transforms. *Pattern Recognition*, 73, 111-130.
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Leo DORST | Hanan ELNAGHY | Michela MORTARA | Corrado PIZZI | Andreas SCALAS | Michela SPAGNUOLO, The Netherlands | Italy

Geometric Ingestion in GRAVITATE: Resampling, Faceting and Annotation Transfer

Keywords: mesh processing, multiple resolution, mesh segmentation, annotation transfer

Abstract: In the GRAVITATE project, we process semantic and geometric information about scanned artefacts, to provide digital tools for the workflow of archaeological analysis. In this talk, we will focus on the 3-part 'geometric ingestion' pipeline that prepares 3D digital models of artefacts for treatment by our geometric algorithms. Resampling [1] - Archaeological meshes from a high resolution scanner may look fine, but at the vertex level typically contain many defects, such as holes, connectivity errors or intersecting triangles. So we developed an automatic cleaning and simplification procedure, which fixes geometry and topology flaws and simplifies models while maintaining surface details. Faceting [2] - The geometric tools in GRAVITATE attempt to perform reassembly and/or compute geometric properties of the original outside of the broken fragment to characterize them for search. They therefore need a mesh that is segmented into 'fractures' and 'skin' sub-meshes. We call the pre-processing which discriminates those zones faceting. We developed a robust algorithm for faceting, with few tuneable yet archaeologically meaningful parameters. Annotation Transfer [3] - In the GRAVITATE system, each fragment is represented by meshes of different resolutions; the main reasons are efficiency in the processing (if some aspects can be adequately resolved at low resolution; e.g. faceting runs on 50k meshes) and interactive display (such as in a fast web interface).

These different versions need to be kept consistent, not only as meshes, but also with their GRAVITATE annotations (like faceting, or sub-feature labelling). We present an annotation transfer procedure which projects facets from one resolution to another so that further downstream tools (with different resolution requirements) can take advantage of them transparently. The transfer can handle any annotation, i.e., a part of the geometry with specific associated semantics; we believe this practice is crucial to fostering new strategies for CH documentation.

Relevance for the conference: Describes crucial issues involved in handling large 3D meshes for archaeology

Relevance for the session: This is how we approached those issues in GRAVITATE

Innovation: Faceting with intuitive parameters and annotation transfer across resolutions

References:

- Mortara, M., C. Pizzi, and M. Spagnuolo. 2017. "Streamlining the Preparation of Scanned 3D Artifacts to Support Digital Analysis and Processing: the GRAVITATE Case Study." Proceedings of GCH 2017 - Eurographics Workshop on Graphics and Cultural Heritage. Eurographics. ISSN 2312-6124, ISBN 978-3-03868-037-6, DOI 10.2312/gch.20171309
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Dominic OLDMAN | Cristina GIANCRISTOFARO | Jonathan MOFFETT; UK

Semantic search, enrichment and similarity of digital assets

Keywords: GRAVITATE Archaeology Semantic Search

Abstract: The GRAVITATE system uses search, discovery and enrichment processes based on data merged from:

- * different forms of legacy data;
- * computer generated 3D data;
- * enrichments extracted from free text through Natural Language Processing (NLP);
- * ongoing research contributions.

GRAVITATE helps identify relations across archaeological fragments whether physical or conceptual in nature. Problems arise from using institutional catalogue data and algorithmic analysis of 3D data of ancient artefacts which are eroded and damaged. There are both benefits and problems in attempting to enrich data using NLP. It is therefore crucial that enrichment is also based on human expertise, whether directed specifically at the GRAVITATE objectives or information taken from other research projects, but which nevertheless generates contextual information to improve artefact knowledge generally.

Existing forms of documentation are usually not designed with reassociation in mind, as they are created in forms that are not readily transferable to a knowledge-base or which lack the richness required to make good inferences. The use of geometric data to establish physical similarities (fragments of the same object) or stylistic and decorative relationships, provides a way to help the

matching and association processes. The narratives that are often included within an institution's structured data records provide additional context but require algorithms to extract and integrate relevant data into a combined knowledge graph. These narratives are of variable quality and NLP can have difficulties in recognising context within text, and therefore identifying rich or accurate relationships. However, combining all these forms of enrichment, and using an environment that encourages active participation and human-led enrichment, provides the means for researchers to refine and narrow down artefacts into groups for which physical and conceptual relations can be found. This has the added benefit that it may reduce overall effort and resources.

Relevance for the session: Semantic Searching is an integral part of the GRAVITATE system

References:

- Low, Jyue Tyan & Doerr, Martin, 2010. A Postcard is Not a Building: Why we Need Museum Information Curators. CIDOC;
- Oldman, Dominc, Doerr, Martin & Gradman, Stefan. 2010. "Zen and the Art of Linked Data: New Strategies for a Semantic Web of Humanist Knowledge" in Schreibman, et al (ed), A New Companion to Digital Humanities. Wiley-Blackwell.

Ilan SHIMSHONI | Niv DERECH | Magali SEGAL-STOLARSKY | Ayellet TAL, Israel

2D color based and 3D based reassembly algorithms

Keywords: GRAVITATE, Reassembly, Complimentary matching, 2D, 3D

Abstract: One of the three main capabilities of the GRAVITATE project is reassembly. A reassembly algorithm is given as input a set of fragments of archaeological artefacts and its goal is to reassemble the object from these fragments. The task is quite challenging since the fragments are abraded, their colours have faded and some of the fragments might be missing or not be related to the artefact to be restored.

In this project we worked on two problems. The first one reconstructs a planar object such as a fresco from images of its parts taking into account the colours of the fragments and their shape. The algorithm first extrapolates the images and matches them to other images. The matches are ranked by the quality of their matches and their uniqueness. The best matching pair of parts is chosen for reassembly. Then more parts are added improving their local transformation. The final output is the complete object.

The second algorithm deals with scans of 3D fragments. Colour information is not assumed to exist. The first step of the algorithm is applying faceting to the meshes, yielding the facets of the fragment and their boundaries. Here instead of extrapolating the fragments we analyse the differential properties of the points on the facets trying to eliminate possible matches between pairs of fragments. On the remaining pairs an approximate relative transformation is computed and only on pairs of boundary curves which satisfy this condition the curves are matched. The matches are then ranked by measuring the distance between closest points on the two fragments. The best ranked matches are returned by the algorithm.

In future we plan to complete the total reassembly of 3D fragments and combine the ideas of both algorithms for dealing with coloured 3D objects.

Relevance for the conference: The algorithms reassemble archeological artefacts

Relevance for the session: This work is part of the GRAVITATE EU2020 project

Innovation: Dealing with generally shaped, abraded and faded fragments is difficult compared to regular rectangular pieces

References:

- Paikin, Genady, and Ayellet Tal. "Solving multiple square jigsaw puzzles with missing pieces." Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition. 2015.
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Digging Archaeological Data: Documents, Archives, Data Extraction and Visualization

Organizers: David BIBBY | Manuela FISCHER, Germany | Christoph BLESL, Austria | Günter MÜHLBERGER, Austria | Martina TROGNITZ | Christoph HOFFMANN, Austria

An archaeological archive functions as repository for excavation data resulting from situations which can seldom – more likely – never be reproduced. The archive preserves knowledge about find spots and sites containing potential answers to many and various questions and queries asked by science, cultural heritage, regional planning, tourism... But where does this data come from? Is it “born digital” or digitized? How big is the data? How was it produced? Does the data need to be big? Are tried and tested systems available for successful digitization? Are new innovations necessary? What about data integrity and project design – which is, or should be the stage at which work specifications and methodologies are formulated, research aims and objectives identified and thus archive creation and compilation begins.

This workshop will offer an opportunity to hear presentations on and discuss subjects as far ranging as basic project design, data management, preservation, integrity, infrastructure and sustainability and, with a view to and future visualization and utilization, meaningful meta data; digitization of varied analogue records and combination of diverse information in GIS as an archiving tool as well as presentation of the data for varying needs. Only through successful archiving and curation will this “data mountain” remain sustainably accessible at grades of granulation appropriate to a wide range of interested parties ranging from the experts of research institutes and state departments through science, cultural heritage, tourism and the interested public.

Duncan BROWN | Claire TSANG, UK

High-speed Morons

Keywords: Data; consistency; access; re-use

Abstract: One important thing to remember when creating any dataset is that in the future other people may want to access and utilise it. If this is kept in mind during data collection it is highly likely that what you create will have future currency. All too often, however, it seems that when digital

information is compiled for an archaeological archive fundamental elements are overlooked. There may not be a concordance or glossary of codes used to describe, for instance, pottery fabrics or forms; file names are not self-evidently related to their content; folder structures are either non-existent or overly complicated. These shortcomings result in a digital resource that renders it impossible to visualize anything. This short paper will introduce an actual digital archive, as submitted for curation to the Archaeology Data Service and show how difficult it is to locate or comprehend any of the data included within it. Basic omissions and errors will be examined, unravelled and resolved. The exercise formed part of a series of training workshops organized by the Special Interest Group for Archaeological Archives of ClfA (The Chartered Institute for Archaeologists) in the UK. Using the archive as submitted, workshop participants were asked to answer twelve questions, some of which were unanswerable. This talk will revisit some of those questions and show how, with some thought and organization, the archive could have been structured to enable access and re-use. Computers cannot (yet) understand what has not been entered into them and therefore cannot act intuitively. Archaeologists must therefore continue to treat them as literal fools and when they create digital data, remember their responsibilities towards their contemporaries and successors. In other words, they have to visualise the archaeological archive.

Relevance for the conference: This is an exploration of how it is possible to obscure a vision of the past without a proper consideration of who the future viewer might be

Relevance for the session: This paper addresses the gap between theory and practice in the creation and presentation of digital data

Innovation: This is a presentation of an interactive training tool that is intended to improve the consistency of digital data creation

References:

- <http://archaeologydataservice.ac.uk/arches/Wiki.jsp?page=The%20Standard%20and%20Guide%20to%20Best%20Practice%20in%20Archaeological%20Archiving%20in%20Europe>
- <http://archaeologydataservice.ac.uk/advice/selectionGuidance.xhtml>

Vincent CHRISTLEIN, Germany

Writer Recognition in Historical Documents

Keywords: Writer recognition, historical documents, writer retrieval

Abstract: Handwritten documents were a fundamental part of communication until the end of the twentieth century. Thus, there is a large historical stock of handwritings, which is gradually digitized, and the subject of research in many respects. In this presentation, the focus lies on automatic writer identification and retrieval. While a paleographer or historian can typically differentiate well different scribes, the sheer mass of available documents make an exhaustive search infeasible. In this presentation, we first give an overview of the development of writer recognition. We show that in clean benchmark data, only a small portion of text is necessary to obtain very high recognition results. However, historical data is much more challenging due to different preservation conditions generating artifacts in the digitizations, such as rips and holes. In the remainder of the presentation, we focus on methods dealing with historical data. We suggest a method to learn robust local features by means of deep neural networks in an unsupervised fashion. These local descriptors are then encoded to form a

global representation. Eventually, these representations are classified with exemplar classifiers. We evaluate our method in a large historical dataset, consisting of more than 700 writers, where each writer contributed five samples. Our proposed method obtains a recognition accuracy of nearly 90%.

Relevance for the conference: Obtaining the correct writer in large historical datasets can be very time consuming, therefore assisting methods can be of great help to speed-up the process.

Relevance for the session: Writer recognition methods trained on clean benchmark data typically do not work well for historical data, such as archeological material.

Innovation: We compare the work in common writer recognition benchmarks with realistic scenarios using historical data.

References:

- V. Christlein, M. Gropp, S. Fiel, and A. Maier. "Unsupervised Feature Learning for Writer Identification and Writer Retrieval". In: 2017 14th International Conference on Document Analysis and Recognition. Kyoto, Nov. 2017. doi: 10.1109/ICDAR.2017.165
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Zdenka KOSAROVÁ | Martin KUNA | Olga LEČBYCHOVÁ | David NOVÁK, Czech Republic

The Archaeological Information System of the Czech Republic – The Big Solution for Big Data

Keywords: Research Infrastructure, Open Access, Big Data

Abstract: A high-quality, linked and easily accessible information for professionals and the wider public is central to driving development in the field of archaeology, protecting our archaeological heritage and promoting public relations.

The Archaeological Information System of the Czech Republic (AIS CR) is an infrastructure designed to integrate digital resources on Czech archaeology. Its main aim is to apply the information system of the Archaeological Map of the Czech Republic (AMCR) in practice, to enhance it and to link it to other data sources. In addition to the AMCR, other resources that fall under the AIS CR remit include the Digital Archive of the AMCR, the Archaeological Atlas of the CR, Archaeology Online, and Prague – The City of Archaeology.

The AIS CR is tasked with three main challenges: (1) to oversee the daily data management of all archaeological activities, (2) to support research and development and (3) to promote the archaeological heritage of the country. To meet these challenges, the AIS CR has committed itself to (1) providing appropriate well-designed tools and (2) sharing data in an accessible way.

Building a high-quality research infrastructure has long been one of the central tasks of the Institutes of Archaeology of the Czech Academy of Sciences. After an intensive period of building experience and performing a number of experiments and pilot studies, the institutes are now equipped with the necessary tools and resources to oversee the management and development of an archaeology infrastructure for the Czech Republic. The all-new, modern version of the AIS CR is the result of an intensive period of work and collaboration within the archaeological research community.

And now after a full year in operation, the opportunity has come to evaluate the performance of the system for the first time.

Martin MOSSER, Austria

Considering useful archiving of archaeological visualisations in Vienna

Keywords: WebGIS - public presentation - digital museum

Abstract: Being aware of the lack of permanent solutions concerning digital data storage the department of Urban Archaeology of Vienna is using visualisations and photogrammetric methods in a quite careful way. The visualised archaeological record has to be closely linked to special issues or particular public presentations, otherwise you would produce a mass of perhaps unusable data in the future. Before having adequate solutions for this problem at the present moment the "traditional" way of documenting by CAD seems to be the most stable approach, especially concerning data exchange and further processing. But a quite useful application area for visualisation should be the record of protected monuments for a future comparison with the status quo. One possibility for a reasonable archiving of visualised data is considered by an elaborated Web-GIS which will contain the whole archaeological record of the city of Vienna in combination with corresponding visualisations. Another approach is a common digital storage solution together with the "Wien Museum" as a kind of a digital museum. But these are all visions for the future and could only be realised by a masterplan which should be urgently prepared in a next step together with all involved archaeological institutions and museums in Vienna.

Hans RESCHREITER | Kerstin KOWARIK | Anke BACHER | Daniel BRANDNER | Julia KLAMMER | Johann UNTERBERGER | Josef WEICHENBERGER | Gabriel WURZER, Austria

7000 years, multilayered research in and around Hallstatt

Keywords: Hallstatt, Visualization, Cultural Heritage

Abstract: 7000 years of salt production formed a unique industrial and cultural landscape stretching far beyond the narrow limits of the Hallstatt High Valley.

An extraordinary amount of archives holding information about the history of this landscape as well as prehistoric and historic lifeways exists. The spectrum of data sources is broad and highly varied, ranging from large inventories of prehistoric organic remains preserved in the salt mines, to hundreds of archaeological sites in the wider region, to environmental archives such as bogs and mires, to written records and cartographic materials.

But the wealth of information to be gained from these archives stands in marked contrast to the visibility of these sources located e.g. 100 m below the surface in the salt mines or on the floor of 126 m deep lake Hallstatt.

Presenting this varied and complex history to the wider public is one of the most important challenges of our research endeavours in the years to come. Focal points of our public outreach strategy include i) building an understanding for the workings of networked multiproxy research, and ii) mapping out the complex and multilayered data network fuelling the research into this unique region.

Part of this research is currently carried out within the Interreg Central Europe Project VirtualArch which focuses on exploring new solutions for visualizing „hidden“ cultural heritage.

Martina TROGNITZ, Austria

Preservation of Archaeology Data in ARCHE

Keywords: Digital Archive, Preservation, Humanities data

Abstract: At the Austrian Academy of Sciences a digital archive, ARCHE (A Resource Centre for the HumanitiEs), was established in 2017. It was awarded the CoreTrustSeal, a core level certification for trustworthy data repository systems, which requires to have in place a set of standards and policies. ARCHE welcomes data from all humanities fields and accepts a wide array of types of data, such as digital texts, lexicographic resources, semantic resources, tabular data, databases, digital images, file collections like GIS, 3D or CAD, media files, and many more. Thus it is a perfect match for archaeological data.

For understandability and findability of data a bespoke metadata schema was developed, which serves as a basis for the display of the archive's content and the search functionalities. The schema includes properties to include spatial and temporal information, with means to provide persistent identifiers like IDs from GeoNames or PeriodO, in order to enhance interoperability and machine processability. Interoperability is also enhanced by the provision of different endpoints, like e.g. a SPARQL and OAI-PMH.

An overview will be given on how data and metadata in ARCHE is presented to the user, what policies were set up, and what functionalities we plan for the future. Within the context of the workshop, we would then like to discuss which features are essential for ARCHE to satisfy the needs of archaeological research and work out any further desired features.

Relevance for the conference: The presentation will introduce a digital archive for long term preservation of data from all humanities fields, including archaeology.

Relevance for the session: Besides elaborating on the functionalities of the archive a discussion among the workshop participants aims to discern which features the archive should provide in order to satisfy the needs of archaeological research.

Innovation: ARCHE is the only archive in Austria that was awarded the CoreTrustSeal so far.

References:

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- E. C. Kansa, S. Whitcher Kansa - We All Know that a 14 is a Sheep: Data Publication and Professionalism in Archaeological Communication, Journal of Eastern Mediterranean Archaeology & Heritage Studies, Vol 1, No. 1 (2013), 88-97

Despoina TSIAFAKI | Natasa MICHAILIDOU

Ways to cope with the scientific ARENA: taking the results of archaeological research a step further

Keywords: archaeological research, digital archaeology, public archaeology, Northern Greece, learning

Abstract: The digitisation of the available scientific results in ways that make them easy to manage and help create new knowledge is always a requisite. Within archaeology, the activity of digitisation has focused in digitisation in 2 or 3D of excavations and geographical information, of movable and

immovable finds, of the relevant literature and the relative data, which was held in excavation diaries, was presented in printed publications and now becomes available in off and online repositories.

Within this framework this paper presents the ARENA project (Archaeological REsearch in the North Aegean). The main theme of ARENA is the collection, management and presentation of the archaeological research conducted in Aegean Thrace and generally the northern Greek territory. The goal is the transformation of the traditional research into digital archaeology accessible and usable to everyone. A multidisciplinary approach is used, bringing together traditional archaeological research and the use of new technologies.

The aim of ARENA is a) to give an integrated perspective (with space-time characteristics) to the researchers of Aegean Thrace and to facilitate their work, but also b) to provide the general public (locals, tourists etc.) with a tool in order to better understand and approach the archaeological knowledge regarding Aegean Thrace.

Through this approach the objective is to create different tools and repositories presented through an online platform where 1) the available archaeological publications for the Aegean Thrace region will be gathered, 2) the ancient sites and the relevant research will be presented following chronological, spatial and other criteria and 3) the results of the archaeological research will be available in forms easily accessible by the public and schools.

The ultimate goal of ARENA is to deliver a digital platform that will serve as an infrastructure tool for the archaeological research in Northern Greece, for both specialists and the public.

Relevance for the conference: The relevance of the paper for the conference lies in the discussion within the ARENA project of ways that take the documentation of the archaeological research regarding an area a step further, through the digital collection, management and promotion of its results for the public and the researchers.

Relevance for the session: The relevance of the paper to the session "Smart ways of building up digital collections in libraries, archives and museums" lies in the aim of the ARENA project to create a digital collection (constantly enlarging) regarding the archaeological research of Aegean Thrace and to open this collection to both academics and the public.

Innovation: The innovation of the project presented lies in its great contribution for the future of both the archaeological research in the understudied region of Aegean Thrace and more generally for the digital management and promotion of its cultural reserve to scientists and the general public.

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Training

Professional presentations

Organiser: Carmen LÖW, Austria | Nadine ALPINO, Germany

Archaeologists are confronted every day with the task of communicating their work to a diversity of audiences or target groups. Whether it is public lectures for interested people or presentations of prospection results for construction committees in local communities, the speakers are increasingly confronted by an audience that is spoiled by the media with peppy pictures and pithy slogans. Also, the attention span in our multimedia world seems to be decreasing, regardless of the impact of the subject.

Unlike in North America, where school children are already trained in rhetoric, such topics are usually not covered, not even in universities, in the German speaking areas. However, in an increasingly international and trans-disciplinary, as well as in a more and more competitive Archaeology, these skills are becoming increasingly important.

In the workshop “Professional Presentations”, the general, theoretical background of communication will be conveyed: How to structure a lecture? How to create a continuous thread for the audience? In what different ways do people acquire knowledge? And what kinds of speakers are there?

For this purpose, the most common presentation tools are presented and illustrated by examples. The workshop will not only deal with the widespread software PowerPoint (and answer questions such as how much text one can use or how much time one has to plan per slide). It will also cover other IT tools, which are trendy in other disciplines – such as Prezi and Impress. In addition, the often inconspicuous classical tools, such as flip charts and objects, are shown with their many possibilities. Participants will be able to explore these and other topics under the expert guidance of the workshop organizers.

The 180-minute workshop is divided into theoretical knowledge transfer and numerous exercises, in which the participants can put their new skills to the test. In an atmosphere of open dialogue, there will be plenty of opportunity for mutual exchange and questions.

POSTER

Chair: Peter DORNINGER, Austria

Carolina BARZACCHINI | Giovanna PATTI | Mirco PUCCI, Italy

Ventotene, from a story of Mediterranean isolation to the Digital survey and interpretation of the thermal area in Villa Giulia

Keywords: digital survey, 3D reconstruction, 3D laser scanner, Ventotene, Villa Giulia

Abstract: This research concerns the study of the archaeological site of the “Villa d’Otium” (The Villa for idleness) from the Augustan Roman age, on the Island of Ventotene: Villa Giulia (Giulia’s Villa). All the activities have been developed thanks to a collaboration with the Ventotene Municipality and in particular with the former director of the archaeological museum of the island, both with the objective of investigating the site and producing a series of materials that would allow further study about this archaeological sites. The task involved the survey, by means of 3D laser scanners, of the Villa’s baths area and some adjacent spaces, to obtain a digitalization of the site. An in-depth study was carried out in the literature about the typology of the “Villa d’Otium” maritime and on the functioning of the Roman baths, and an analysis about the archaeological evidence as well as from the gathered dataset, to formulate a digital reconstructive hypothesis of the baths area of the villa and its heating system. Furthermore, the production of three-dimensional models made possible to give accessible materials to the public for information and educational purposes. Finally, an architectural project and a reorganization of the visiting paths were proposed to redefine the entrance to the archaeological site, which today is very precarious, with the aim of enhancing the comprehension and safeguarding this historical-archaeological heritage.

Alena BISTÁKOVÁ | Elena BLAŽOVÁ | Peter BEDNÁR | Matej RUTTKAY, Slovakia

An evidence of archaeological activities in Slovakia

Keywords: evidence of archaeological activities, digitizing, database, ISAU, Slovakia

Abstract: In 1939, the Institute of Archaeology at the Slovak Academy of Sciences began developing a central register of archaeological activities in Slovakia. The primary database of the register comprises research reports of archaeological activities and other written records related to archaeological finds. This database is directly linked to photographic archives that document field activities and archaeological artefacts. The research depositories of the Institute record hundreds of thousands of finds divided into databases of vessels, small finds, pottery, anthropological material, archaeobotanical samples, animal bones, etc.

Because these databases contained so much information, it was necessary to prepare a central, mutually interrelated geoinformational structure. Thus, we developed an application that allows simple and fast access to the information. The application can be modified to add new data fields or data sets, and the system integrates various types of databases and digital supplementary materials. In addition, the system includes a database of archaeological artefacts from specific times and places. The application can track an artefact on the basis of its storage codes, current place of loan, or restoration documentation. It permits online editing of individual entries within a predefined personal

manager interface, provides opportunities for scientific research, and allows analyses using multiple search criteria.

The aim of this project was to develop an information and communication centre that includes a database of archaeological and relevant spatial data from Slovakia. The system is designed for the scientific and general community, as well as for local municipalities, to ensure that archaeological finds are more thoroughly protected and used in education, tourism, and other activities.

The first – trial – version of the geoinformational system is currently available on the Geoportal.sk website.

Marco BLOCK-BERLITZ | Benjamin GEHMLICH | Michael BOMMhardt-RICHTER | Hilmar BOCHMANN, Germany

Archaeological underwater documentations with Manio

Keywords: underwater archaeologie, UUV, wireless communication, intelligent buoy

Abstract: “Manio” is our unmanned underwater vehicle (UUV), a customized design based on the BlueROV 2 from BlueRobotics. It can be controlled via a cable of up to ten kilometers in length, although 300 meters have proven to be enough for regular use. This is a standard issue by the manufacturer. The UUV has a large number of sensors, such as an inertial measurement unit (IMU) and a forward-looking camera. The latter streams images in real time to a computer at the base station, allowing the pilot to see exactly what is in front of the UUV. To accommodate for different documentation areas and environments, different side arms have been developed with flexible camera and lighting setups. It is possible, e.g., to use possible to use a variety of action cams with variable stereo overlap. A quick-clamping system is used for fast swap of arms. Another important modification is to leave out the control cable. This is achieved by using a buoy to communicate with the UUV. Inside the buoy, we have a Rocket Prism Gen2, outfitted with two omnidirectional antennas. The orthogonal antenna alignment causes the radio waves to propagate in parallel through the water, allowing for long communication distance. The buoy's power supply is based on a common 5.000 mAh LiPo battery with three cells and a service time of up to four hours. The base station is placed close to the water, with a directional antenna orientated in the direction of the buoy. This wireless system can communicate across a distance of up to one kilometer. The power supply of the Nano Beam Gen2 is similar to that of the Rocket Prism Gen2, making this a flexible and convenient setup. The problem of underwater localization is addressed by another video live stream from the UUV. This makes use of the GoPro's integrated wireless module and USB WiFi antenna connected to the UUV's on-board computer. Because WiFi reach is extremely limited under water, both antennas must be placed very close to each other. Our solution is to extend the UUV's antenna with an antenna cable and place it directly onto the GoPro's case.

Michael BOMMARDT-RICHTER | Marco BLOCK-BERLITZ | Benjamin GEHMLICH, Germany

ArchaeoPlanner: Planning semi-autonomous underwater campaigns

Keywords: UUV, Simulator, MissionPlanner, archaeological documentation, real-time 3D reconstruction

Abstract: The support of automated surveys in the field of archaeological documentation is already very advanced and is approaching the requirements of manual aerial surveying more and more. In this field are programs used that provide so-called 2.5D models (pure terrain elevation models). Normally different flight strategies are used to deliberately record complex situations in order to create 3D models. These methods are realizable by using GPS positioning and local distance sensors. In the underwater area, the reception of GPS and therefore an automated documentation of underwater situations for low-cost submarines are not easy to handle. To prepare the ground and start future solutions, based on the real-time 3D reconstruction with the ORB-SLAM module for real-time localization of the mini-submarine “Manio”, ArchaeoPlanner was developed. It is used to plan and test a documentation mission offline. “Manio” is based on the BlueRov 2 and has been upgraded with a buoy for easier handling and increasing the range. ArchaeoPlanner consists of three modules: MissionPlanner, SubControl and VirtualSub. These three modules work in a pipeline. For example, the MissionPlanner first creates a documentation pattern consisting of the direction in degrees and length in meters. Scaling is necessary when driving a mission because accurate meter reading is currently not possible. This is implemented by a factor. The factor allows missions to scale larger and smaller. Within SubControl there is also a live image of the internal camera. With this image it is possible to control the submarine manually. In addition, the current GPS position of the buoy can be seen. The documentation pattern can be tested in advance in the simulator VirtualSub. After the virtual environment as well as the mission in SubControl are started, the virtual diving session can be seen directly. So, it helps to get a better valuation about the behavior of the submarine. After the mission has been planned and reviewed, it can be executed directly. Via SubControl it is possible to communicate directly with the original software QGroundcontrol, using a virtual joystick, as well as controlling “Manio”.

Barbara BUCHER | Andreas KOLBITSCH, Austria

Mapping Heritage in Vienna

Keywords: built heritage, map, heritage policy, open data

Abstract: Vienna’s 1st municipal district is an area dense with built heritage. We created a public map in Google Maps in which we combined public data provided by the City of Vienna and the Federal Monuments Office in 8 separate layers. The map has two functions: first, it gives an overview over different legally protected areas, such as the UNESCO World Heritage site “Historic City Centre of Vienna”, or protected zones according to the Building Code for Vienna. Second, the map holds information on the 670 individual buildings that are protected according to the Austrian Monuments Law.

With regards to the legal areas of protection, viewers can choose between three layers visualizing the core and buffer zones of the World Heritage site, protected zones and the ensemble “Vienna City Centre”. By selecting multiple layers at once, viewers can see where areas overlap and buildings

therefore enjoy triple legal protection, but can also instantly locate gaps where this is not the case. Five further layers of the map display the individually protected buildings according to the Austrian Monuments Law. One layer shows all these buildings without further discrimination. Another layer shows buildings protected by legal presumption and buildings protected by order. The viewer can select three additional layers, which show building characteristics such as the number of storeys, original roofs and use. By clicking on a building in either layer, a pop-up window provides additional information, such as alternate addresses, year of construction and architect.

Our map is an easy visualization of the complex legal construct that protects the built heritage in Vienna. It allows viewers to easily identify areas with dense legal protection and in addition provides easily accessible information on listed buildings.

Zeynep CEYLANLI | Pembe ÖZEN | Ezgi ÇIÇEK | Pelin ARSLAN, Turkey

Evolving from castle to virtual space: the case of Kyrenia Shipwreck Museum

Keywords: Museum Design, Site Specific Museum, Digital Museum, Kyrenia Castle, Museum Pedagogy

Abstract: The past twenty years have seen a progressive innovation in the approach to the museum pedagogy, an increasing use of digital solution has more and more influenced the way the items, the history and the knowledge are transmitted. The architectural design aspect of such interventions is influenced by these new approaches increasing the need of knowledge about technology solutions owned by architects and cultural heritage experts. These rules are applied in many cases of new museum constructions, but often they must also be applied in existing museum exhibitions. In the case presented here, the Museum sector of the Kyrenia castle, in the town nowadays named Girne, in North Cyprus, place of the exhibition of one of the first underwater archaeological finding, will be taken with all its specific issues and will be analyzed and presented as an exploring experience of new multimedia/traditional solutions, cataloguing some interesting and well promising solutions for media integration and online/site specific integration, together with contemporary materials/exhibition solutions in the aim of a renewal proposal capable of bringing in the digital age and enhancing the quality of the visiting experience of this interesting museum/castle. The case under scrutiny gives us the opportunity to reveal the layers of different phases of the castle as well as an antique shipwreck with the use of 3d digital survey of the architectural space, which concomitantly leads the way for the museum design solutions to cooperate with the digital technologies.

Ambra COLACIONE | Paolo FORMAGLINI | Filippo GIANANTI | Alessandro GIACOMELLI, Italy

Old and New school The evolution of the survey campaign in a case study of Maddalena's Bridge

Keywords: Photogrammetry, Structure from Motion, Maddalena 's Bridge, Data comparison

Abstract: How can we make the heritage built around us available through the new digital survey technologies?

The Maddalena bridge, in Borgo a Mozzano (LU) Italy, called "Devil's Bridge", is a monument of particular historical interest and it has been analyzed here with the aim to identify new way about how to use the data of a survey campaign through using different technological methodologies (laser-scan

and photogrammetry) and new SFM software. The use of both data allows a greater knowledge of detail and better management of the survey campaign timing.

Some buildings, such as a bridge, located in particular topographical conditions may present some difficulties with survey 's technologies. In this case, the water affected the normal return of the data through the laser scan; also the photogrammetric survey sessions obviously present physical barriers such as in our case the river, not navigable at the time of the survey campaign.

Therefore, the combined use of both laser-scan and the photogrammetric survey was indispensable in order to provide better detail accuracy. The new survey made in 2018 and its graphic restitution of Maddalena 's Bridge, wants to offer itself as a usable basis to benefit from a comparison with a previous survey carried out in 2006, allowing us to analyze and compare the status of the current fact with the previous one and thus allowing to hypothesize possible consolidation and redevelopment interventions if necessary.

It was thus possible to highlight the changes offered by the new technological solutions that we now have available (the evolution of the Laser-scan, optical devices and cameras, software and digital components) that allow us to implement the knowledge of the survey.

Thanks to the survey itself, it was possible to create a 3D digital model available for complete use of the monument for tourism purposes.

Iulia DANA NEGULA | Cristian MOISE | Radu Claudiu FIERASCU | Irina FIERASCU | Constantin Ioan INEL | Ioana POPITIU, Romania

A multidisciplinary approach for cultural heritage management and sustainability

Keywords: remote sensing, nanotechnology for conservation and restoration, digital reconstruction

Abstract: Cultural Heritage has a major significance for the local community. The bond between heritage and community represents a bridge that connects the past and the present and it symbolizes the legacy that will be passed on to future generations. Recent studies show that the link between heritage and community "generates values like identity, tradition, the feeling of belonging, social cohesion". Moreover, the local communities acknowledge the benefits of heritage that primarily reside in tourist development followed by the safeguarding of the local identity and traditions and knowing of the past. Likewise, cultural heritage has a critical value in building and cultivating the local identity. The undeniable process of climate change increases the vulnerability of the natural and cultural heritage sites. Considering the long-lasting efforts carried out to protect and preserve the cultural and natural properties, a special emphasis is put on heritage management and sustainability and also on the implementation of the digital heritage concept. In this context, the knowledge of the current state of conservation is essential. Suitable for both cultural and natural heritage, satellite data enables the generation of custom-made monitoring products, such as land use and land cover maps, multi-temporal analysis and change detection, digital elevation models, displacement maps, etc. The RO-CHER project ("Multidisciplinary complex project for the monitoring, conservation, protection and promotion of the Romanian cultural heritage") proposes a multidisciplinary innovative approach for safeguarding the cultural heritage. It aims at monitoring the cultural heritage objectives with the support of space technologies, developing materials and innovative techniques based on soft nanomaterials, recommending an integrated management system (conservation, restauration,

protection), and promoting cultural heritage by using state-of-the-art technologies of digital reconstruction. The results of the project will support the national and local authorities responsible for the protection of the cultural heritage.

Dennis DEKKER, The Netherlands

's-Hertogenbosch

Keywords: medieval city gate, digital and visual media, public excavation, 3D reconstructions, timelapse videos

Abstract: 's-Hertogenbosch, The Netherlands: in the summer of 2016 an archaeological excavation took place to unearth the history of a medieval city gate, the so-called 'Pieckepoort'. The excavation was organized by the Heritage Department of 's-Hertogenbosch Municipality. This poster aims to provide solutions to the challenge of bringing the general public closer to archaeological heritage. To reach the audience, innovative techniques were applied using digital and visual media.

It was the city's first large-scale public excavation, which attracted media attention and was assisted by the work of many volunteers. The excavation could also be followed from special viewing points on the top of two containers and by a webcam.

Various visual applications have been developed to reach the public. 3D reconstructions and timelapse videos have been made to share on different online channels. And thanks to 360 degree photography it is possible to offer a virtual tour of the archaeological excavation. An educational game is being developed for children and youngsters. They can use virtual reality glasses to explore the Middle Ages and the area around the old Pieckepoort. In the meantime they can come in contact with historical characters and search for objects that were found there during the archaeological excavation.

Thanks to the use of these new techniques and by visually presenting the heritage, we were able to reach a larger and wider audience.

Bruno DUTAILLY | S. EUSÈBE | V. GRIMAUD | N. LEFÈVRE | M. QUANTIN | S. TOURNON
VALIENTE | M. CHAYANI | X. GRANIER, France

Life cycle of 3D data for Cultural Heritage

Keywords: Archiving - 3D - Cultural Heritage- metadata

Abstract: 3D is now commonly used for Cultural Heritage study, valorization and preservation. The gathered experiences make possible to define standard processes and practices to ensure data quality and their preservation. Under the supervision of the French national infrastructure for digital humanities (Huma-Num), the 3D Consortium has thus defined a life cycle of such data from creation up to archiving. It was part of its missions that are: bring together groups working in the field of archaeology and cultural heritage and with experience of using 3D technologies and producing 3D models; define the vocabulary associated with 3D technologies for HSS; develop specific open-source 3D tools; disseminate good practices and commissioning a conservatory dedicated to 3D data. We have formalized the different steps of data life Cycle. The first step consists in collecting data production from capture device (laser scanner, digital camera...). Such data which are denominated A0. The second step consists in processing the data (cleaning, meshing,...) to create the initial models

V0. Finally, new modeling may be added to add new hypotheses for the restitution. This step may be iterated creating V1n versions up to the V2 that is the final version. A supplementary step may be added when valorization is considered. All versions from A0, V0 up to V2 are candidates for archiving. We have formalized this process with a sequential graph that introduces a metadata new schema dedicated to the long-term archiving of 3D models for HSS. We have also created a software aLTAG 3D, that leverage the usual complexity of documentation to create metadata and of checking that the 3D files are suitable for archiving. It creates an archive that can be pushed to the CINES – the French national infrastructure for high-performance computer, and for long-term digital preservation.

Ángel M. FELICÍSIMO | María-Eugenia POLO | Trinidad TORTOSA | Alicia RODERO, Spain

Rollout archaeological photography for the graphic documentation of cultural heritage

Keywords: Digital photography, Graphic documentation, Rollout photograph

Abstract: Peripheral or rollout photography is a non-destructive technique that aims to “unroll” the surface of an object in order to represent it on a flat surface and to obtain a more comprehensive and continuous view of the object’s decorative motifs. This technique is especially useful when applied to cylindrical objects. Rollout photography was developed in the mid-twentieth century and was further developed in 1970 when Justin Kerr made a series of hundreds of rollouts of Mayan vessels that can be seen in <http://www.mayavase.com/>. Recently, this process has been simplified with the advent of digital photography. Currently, it is possible not only to use conventional cameras but also to work with filters and digital treatments that go beyond the traditional photo. Digital rollout image in archaeology offers the opportunity to completely visualize decoration, thereby providing detailed analysis and documentation by allowing the integration of iconographic content of three-dimensional structures with decorations in all sides, shown by the same two-dimensional aesthetic narration. This poster will present the methodology necessary to obtain high-resolution rollout images considering all technical aspects from the photo shoot to digital processing. In addition to highlighting issues that have not always been accurately addressed, such as colour calibration, we will show our own development techniques to merge and “unwind” the images. Finally, we will explain how the application of specific filters (e.g., DStretch) can reveal aspects of decoration that are not clearly visible in the conventional image, improving its documentation and thus providing a thorough reading for the study of these collections. This process will be applied to the so-called “The Warriors’ Cup” of Archena (Cabezo del Tío Pío, Murcia, Spain), a large Iberian kalathos from the Hellenistic period decorated in ochre tones, which is currently exhibited in the National Archaeological Museum of Madrid.

Relevance for the conference: We explain some useful methods (rollout photography and DStretch filter) to display the archaeological object from other point of view in exhibitions.

Relevance for the session: We compare the same method (rollout photography) both from the analog and digital perspective using conventional and digital cameras showing 3D information on a flat surface.

Innovation: The improvement of the rollout process using digital cameras and the application of specific filters (DStretch) that can make pictographs visible although are nearly invisible to the naked eye.

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Stéphane GIRAUDEAU | Paolo FORMAGLINI | Filippo GIANANTI, Italy

Video-Photogrammetry: from different sources to 3D model

Keywords: Sfm Photogrammetry, drone, flying-documentation, aerial photogrammetry, video

Abstract: What are the future techniques of photogrammetric survey? What new possibilities will help individual users with photogrammetric survey software in the future? There may be many questions on this subject, but we have chosen to focus mainly on one: having the possibility of creating a 3D model from the digital images? has become an instrument for everyone? Nowadays, any person has, at least in a cellphone, a digital camera and in any electronics store or supermarket, a drone can be purchased easily and at affordable prices. Moreover, not only photos but also the ability to record videos with high quality and detail, today is a possibility for everyone. But how can you benefit from all these available technologies in order to easily create a 3D model? For example, what is the relationship between video and photogrammetric survey? The use of the SfM photogrammetry, through video, can be a great tool for rapid and accurate digitalization, all the models developed could be then edited, simplified and ready to be uploaded to the Sketchfab platform or similar. But moreover, can the capture of light through video recording influence the metric accuracy of the photogrammetric survey? Or, the video recording performed by a mid-range drone, can be a correct basis for developing simple and easy 3D use for architects, game developers, tourism offices, or for any monitoring phase? We will try, through various comparative phases of both tools and software, to answer these questions.

Our aim is to compare the technological possibilities available to an average user in order to verify if the translation of reality into geometric points in space is actually a technology for everyone or if there are still difficulties to be overcome.

Hayat KADI | Karima ANOUCHE | Jean-Pierre PERRIN, Algeria

The best compromises of 3D parametric reconstruction for heritage representation

Keywords: Digital heritage, parametric modeling, 3D reconstruction, data acquisition

Abstract: Within the framework of heritage documenting, three-dimensional reconstruction is the approach that currently offers the best compromise and protection against loss and/or oblivion. Although data acquisition has known significant progress thanks to the introduction of new tools such as 3D laser scanners, difficulties are encountered to effectively exploit and process the achieved data. Indeed, modeling element by element from the measured data is a time consuming. To assist clouds structuring, prior knowledge of the object may be the support of its digital reconstruction that requires geometric interpretations to generate consistent and re-usable models. From the observation and knowledge of the real object, it is possible to define a model describing the building, morphological relationships of its parts, and its geometric rules. It's about describing all architectural components by a minimal set of parameters allowing their reconstruction.

This paper proposes a 3D reconstruction process that tries to facilitate transition from the acquisition and semantic description phases to a geometric modeling. Through the exploitation and digitization of the architectural and archaeological knowledge, this process aims to reach a geometric modeling, where parameterization serves as the principle of interpreting the acquired data. The examples of 3D reconstruction performed on columns and triumphal arches illustrate and explain the approach. It consists of extracting object components through depicting all existing typologies, and to identify parameters describing their geometry. The writing of corresponding algorithms then makes it possible to define parametric components to be implemented into parametric software. This allows the creation of new features and then generation of many models through multiples instantiations, which would adjust to available data (point clouds) for an accurate 3D reconstruction. Away from being solely a case study, the examples serves to explain our process meant to be extrapolated to other same-family objects and generalizable to external typologies, generating thereby models from a minimum of data avoiding the case-by-case basis.

Innovation: The 3D reconstruction process doesn't intend to apply to limited case studies.

Stephan KARL | Paul BAYER | Hubert MARA | András MÁRTON, Austria

Advanced documentation methods in studying the black-figure style of Corinthian vase paintings

Keywords: Computed tomography, Texture mapping, Corinthian pottery, Vase painting, Feature vectors

Abstract: Profile-drawings and tracings are essential elements of a throughout scientific object documentation in archaeological pottery studies. Within the study of Greek pottery, unwrappings of painted surfaces have a long tradition and a still well-deserved high significance. They show the depiction without photographic distortions or sectioning, enabling archaeologists to analyse and interpret the image as a whole. This is especially true in the case of Corinthian pottery, where the poor preservation of the painting tending to flake off often results in unclear photographs. Nevertheless, traces of flaked off painting layers are still visible on the surface under specific illumination.

Creating profile-drawings and unwrappings manually is time-consuming. Manual acquisition with tactile tools like lead wires, profile combs or tracing paper is often not allowed due to the fragile nature of the surfaces. To facilitate this task for pottery archaeologists, we propose a combination of 3D data derived by photogrammetry (SfM) and computed tomography (CT), where each technique can also be on its own. The fusion of different data sources is a new approach. It exploits the specific strengths of these not-contact digitisation technologies: SfM with a high resolution in texture and CT with a high accuracy in geometry as well as with the added value of providing inner surfaces of closed vessels. Having SfM and CT data, we can combine them by transferring colour information to the vertices of the CT model. Afterwards, we use the GigaMesh Software Framework for enhancing geometric features in the surface data, in our case the fine incisions of the black-figure style. Doing this, we are able to create accurate and sufficiently detailed unwrappings aligned to the needs of pottery specialists. Additionally, we can compute profile lines with inner and outer contours and unwrappings of the inner surface showing significant details of the manufacturing process.

Latifa KHALID AL-THANI | Divakaran LIGINLAL, Qatar

A Study of Natural Interactions with Digital Heritage Artifacts

Keywords: digital heritage, natural interaction, eye-gaze, design research

Abstract: In the context of digital heritage, this research investigates how best to recreate in virtual space the natural interaction visitors experience with artifacts in a museum. A key objective is to examine eye-gaze interactions and effective solutions to the related Midas Touch problem. The first phase of the research involved observation of visitors' engagement with paintings and sculptures in five museums in Qatar. Drawing upon the insights gained, the second phase involved building a digital heritage artifact called Al-Lulwa. This desktop application features a collection of mixed media about the history of pearl diving in Qatar presented as a virtual gallery and an underwater scene. Design research methods along with pilot studies helped understand how to control for dwelling and fixation times to address the Midas Touch problem in eye-gaze interaction. An experiment was set up with 60 Arab participants divided randomly into two groups, one of which interacted with Al-Lulwa first with eye-gaze, then a mouse, and finally with their preferred mode. Members of the other group interacted first with a mouse, then eye-gaze, and finally with their preferred mode. Each participant's preference for interaction type and emotional response to the interaction experience was determined by using questionnaires and a structured interview. The group that used eye-gaze had a significantly higher mean affective response to their mode of interaction compared with users who used a mouse (p -value=2.195e-05). After viewing the virtual gallery and the underwater scene using the two interaction modes, both groups of participants had significantly higher affective responses for eye-gaze over mouse interactions (p -values = 4.59e-06 and 1.025e-11 respectively). When presented with a choice, 88% of participants from both groups preferred eye-gaze over a mouse interaction. Also, 92% of participants who preferred eye-gaze stated that eye-gaze interaction felt more natural than a mouse interaction.

Cristian MOISE | Iulia DANA NEGULA | Alina ORTAN | Radu FIERASCU | Irina FIERASCU | Ioana POPITIU | Constantin INEL, Romania

Promoting cultural heritage using state-of-the-art technologies of digital reconstruction

Keywords: cultural heritage, 3D modelling, digital reconstruction

Abstract: The necessity of preserving and capitalising the cultural and historical heritage has led the scientific community to adopt a series of complex, multidisciplinary approaches that will keep the heritage "alive" for future generations. In Romania, with the exception of nearly 30 princeps, also on the UNESCO list, where the monitoring of the authorities has been quasi-permanent, tens of thousands of edifices, monuments, sites and other objectives are in permanent danger to be destroyed or modified irreversibly.

In this context, the overall objective of component project no. 2 within the RO-CHER complex project is the development of an integrated technology for the realisation of virtual digital reconstruction products based on terrestrial laser scanning for cultural heritage objectives and 3D scanning for exhibits.

The project is not limited to 3D reconstruction of the objects / exhibits, but proposes the creation of comprehensive virtual environments in which the associated buffer areas (in the case of cultural

heritage objects) or the premises / buildings where the exhibits are located shall be integrated. The project is committed to the integration of advanced terrestrial laser scanning technologies, spatial information technologies and satellite technologies for the development of comprehensive virtual environments.

This work was supported by a grant of the Romanian Ministry of Research and Innovation, CCCDI - UEFISCDI, project number PN-III-P1-1.2-PCCDI-2017-0413 / contract number 50PCCDI/2018, within PNCDI III

Marco MONTANARI | Lucia MARSICANO, Italy

Bologna 1116 - an interactive experience

Keywords: 3D; virtual reality; bologna; unity;

Abstract: Bologna 1116 is the result of a study conducted by an interdisciplinary team composed of archaeologists and engineers. The research is focused on the history of the city of Bologna during the middle ages and the final result is an application of immersive virtual reality.

The presentation will cover the experience of the creation of the "Bologna 1116" application and the good and bad aspects of a complex archaeological reconstruction in a situation lacking of documents and artifacts due to architectural stratifications and building reuse.

The choice of the very specific timespan and the area is crucial for it being a very complex period in Bologna, as it was not yet the city we know today and was assisting to very important social and political changes, both on a local and a global level. Bologna sees an enormous change in the period between 1080 and 1150: From the birth of the first western university to the construction of the first towers that will in later years characterize the city skyline, to the death of Matilde di Canossa and the consequent shift in the power balance in the western world. The towers were rare, the Asinelli Tower was the first one built in the then city outskirts and the Garisenda was still in construction next to Asinelli.

The result is a 3D reconstruction of the city as it looked like right after the death of Matilde di Canossa. The application shows a city with several construction sites and it is possible to discover how construction work was done during the XII century. This reconstruction was possible thanks to studies and comparisons with other contexts mostly in northern Italy.

In the reconstruction there are visible the daily activities in the city during the day and the night and it is possible to see characters interacting in the streets and buying goods in the marketplace.

The result is pleasant to see but not photorealistic and the standardization of some buildings is a choice to allow the users to understand that the reconstruction is largely hypothetical.

Relevance for the conference: Experience from the field trying to create an interesting edutainment tool keeping in mind the many issues from the world of gaming.

Relevance for the session: Within the session we will propose solutions for the entertainment part of edutainment.

Innovation: Choosing gaming approaches for a CH reconstruction helps easing the users into non obvious educational systems

References:

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Phil MORRIS, UK

Using Inertial Motion Capture to capture elements of Intangible Cultural Heritage

Keywords: Inertial Motion Capture Low cost Preservation Intangible Cultural Heritage Craft

Abstract: Intangible Cultural Heritage (ICH) is a popular area study ever since UNESCO ratified the 2003 Convention, however there have been a number of problems in collecting elements of ICH for inventory particularly those performed in remote areas. ICH is a 'living' phenomena and can be culturally sensitive to preserve, inventory and disseminate. It can be hard, sometimes impossible, to gather physical data on elements of ICH for study or collection. Intrinsically its elements are transient and can even be called ephemeral in nature, or they can take place in difficult or unique circumstances. Many areas of Intangible Cultural Heritage are often overlooked, ignored or are considered not special, elements are found within modern industrial contexts in such areas as Stoke-on-Trent in the Industrial heart-lands of the Midlands in the UK which is internationally famous for its innovations and quality of its ceramics. Games & Film Technology have developed methods of collection which are democratic, affordable and flexible which in many ways mitigate the need for dedicated or expensive studio sessions to capture physical manifestations of ICH. The move to more democratic methods of collection within Universities, Museums and within the general public allows more breadth in the collection of media as cost is less of a prohibitive factor at the sacrifice, in some cases, of quality. In this paper we propose using a new technology that is being widely adopted by both the Games and Film industry, Inertial Motion-Capture, which can capture elements of ICH low cost, in-situ and real-time render / record into a game based world for exhibition and dissemination immediately. The benefits of this new technology are many, especially the ease and utility of such capture methods within the context of original exhibition. This is mitigated by a small reduction in relative quality of the capture compared to studio environments.

Gerald RAAB | Ronny WEßLING | Roman SKOMOROWSKI, Austria

Augmented Reality as support in presentations and scientific communication

Keywords: Marker-based Augmented Reality, AR based on GPS coordinates, Web AR

Abstract: The aim of this poster presentation is to answer the following question:

Which possibilities are offered by methods such as augmented reality, virtual reality and interactive applications as an aid to presentations and professional scientific communication?

From 2014 - 2017 Crazy Eye (crazyeye.at) tested various types of 3D documentation in cooperation with the NHM/Natural History Museum Vienna and Salinen Austria AG and examined their suitability in issues of mining archaeology.

The basis was a wealth of 3D data, like finds, sites, mining tunnels, landscape models and reconstructions of the Hallstatt World Heritage site.

The created objects were then further processed in various free 3D programs such as Blender (blender.org) and Unity (unity3d.com) and prepared for presentation purposes. Also web-based variants independent of the operating system were integrated by using techniques like three.js and ar.js. On the poster all four common variants of modern Augmented Reality tools are presented:

1. Marker-based Augmented Reality
2. AR based on GPS coordinates
3. Markerless AR.

As a fourth variant, the advantages of the web-based variant should also be shown. The graphics and illustrations on the poster are the basis (marker) and should provide a common thread for understanding and experiencing the content first-hand using the AR tools.

For example, a virtual tour through the bronze age mining site of the Christian von Tusch Werk in Hallstatt is made possible directly at the poster's location via smartphone or tablet.

Luciano RICCIARDI, Italy

Could virtual restoration substitute actual restoration? A method proposal

Keywords: Virtual restoration, new technologies, photo retouching, non-invasive interventions

Abstract: The aim of the research presented is to investigate the opportunity of replacing, where possible, the restoration of a work of art by means of virtual intervention. This for a number of reasons: to virtually re-integrate missing areas in a work of art on the basis of proper historical and diagnostic examinations; to avoid tampering with original parts –something that inevitably occurs during an actual restoration; and to limit the number of works which are restored not for conservation purposes, but mainly for aesthetical upgrade. More specifically, this research proposes a method for virtually reintegrating the figurative text of works of arts, where readability is damaged due to the presence of numerous or extensive areas of loss. The method has been developed taking as case study two panel paintings of the XIV century, sited in the Galleria Nazionale delle Marche (Urbino): the Madonna dell'Umiltà, attributed to "Maestro dell'incoronazione di Bellpuig" and the Annunciazione by Olivuccio di Ceccarello. Both representations have been considerably damaged during their conservative history and have incurred extensive loss of authentic pictorial film, even in key sectors, such as characters' anatomical details. These areas of loss have been filled with neutral colors during restoration interventions carried out around 1970, since judged as not interpretable, according to criteria set by Italian Theory of Restoration. Starting with a high-resolution photograph of mentioned paintings, it has been proposed to redefine the missing form and color with AutoCAD and Photoshop, so as to render the paintings virtually intact. In order to recreate the drawing, the research compares graphic surveys taken from other works of the same artist. Peculiarity of Medieval artistic production, indeed, is the use of silhouettes, reproducing standardised shapes. Moreover, part of this research focuses on the theme of virtual cleaning.

Pablo RODRIGUEZ-NAVARRO | Andy CHOPPING, Spain | Diego RODRIGO, UK | Giorgio VERDIANI, Italy | Teresa GIL-PIQUERAS, Spain

Digital applications to urban archaeological sites: the St. Mary Spital. Chapel and Charnel House

Keywords: Photogrammetry, Digital Survey, 3D Reconstruction, London, Charnel House

Abstract: This case study is about an archaeological site in central London, named “The Charnel House”, it is a crypt in a cemetery chapel, dedicated to St Edmund the King and St Mary Magdalene, built probably about 1330. It was located at the Spitalfields suburb, (Spital Yard), actually Bishops Square, E1 6AD London (UK). The site is located below the street level, in a new area that has been completely restructured. Through a public staircase it is possible to access a wall of glass that allows to see a side of the medieval building, although access to the interior remains closed to the public. It can only be visited in groups and upon a booking to Historic England, entity in charge of its management, custody and maintenance. Through this glass it is possible to observe a part of the site. The ruins has been surveyed and documented using photogrammetry solutions to create a base for further virtual 3D reconstruction. A set of references from proper manuals about gothic and neogothic architecture has been the base for this digital modeling. The poster presented here has been made to be placed on the site; It has been arranged inside the glass, suspended from the roof, so that its texts can be read, as well as its images and the QR codes taking to digital 3D models of the site and its hypothetical reconstruction. Also, traceries, jambstones, ribstones that have been used to make the reconstruction and that are in the storage of the MOLA (Archaeological Museum of London) are shown.

Stefania SAVVA, Cyprus

Museum Affinity Spaces: Exploring the potential of a new tool for re-imagining museum-school partnerships for multiliteracies engagement and learning

Keywords: virtual museums; augmented reality; immersive experiences; children's learning

Abstract: The proposed research shall give insights into the potential of immersive virtual environments (IVEs) to act as platforms for engagement with cultural heritage among children of school age. To examine the latter, this paper delves into the Museum Affinity Spaces (MAS) project, an empirically based, pedagogically-driven research initiative funded by HORIZON 2020, entailing plans for a platform targeted at European museums/galleries and learning institutions such as schools and universities, which allows them to form partnerships and be immersed in a virtual environment in order to enrich classroom experience and overcome physical limitations of attending a cultural space. The overall aim of the MAS project is to grant students with opportunities to gain experience of museums and cultural heritage beyond national boundaries and enhance their literacy repertoires by incorporating understandings of technology-enhanced museum learning as a multiliteracy practice. The intention is for school-teachers, museum educators, and students to be able to use a virtual platform themselves and in collaboration with other parties from around Europe and the world, either through synchronous or asynchronous learning to develop learning activities deriving from museums. The project employs design-based research (DBR) and is structured to unfold in three phases: preliminary analysis, the prototyping stage, and implementation and evaluation or assessment. This

presentation shall focus on the preliminary analysis and prototyping stage of the project, as it was carried out during the first months since the project embarked. The most innovative aspect of this project is its theoretical backdrop, as it proposes a novel conceptual framework for developing cutting edge visual interactive experiences and long-term sustainable cultural learning projects between different cultural organisations and schools, defying physical limitations, so as to allow for a network of shared cultural heritage participation and engagement across Europe.

Arnaud SCHENKEL | Rudy ERCEK, Belgium

3D digitization of the Brussels City Hall and the medieval archangel Michael wind vane: architectural and archaeological exploitation

Keywords: 3D scanning, automatic pipeline, archaeological exploitation, multimodal rendering

Abstract: In order to make its architectural and archaeological study, the roofs, the courtyard and the facades of the Brussels City Hall were digitized with a 3D scanner, coupled with photographic acquisitions. Various elements, such as the tympanum of the main portal and the archangel Michael, an exceptionally preserved 5-metre-high medieval metal wind vane that adorned the top of the 96-metres-high tower, were also digitized in high definition. We present two tools : an automated pipeline to clean colorimetric and geometric defects in 3D survey; and a software to easily manipulate all this data with fluidity in the rendering and the manipulation, designed for architects and archeologists users.

The complete acquisitions consist in 97 scanning positions for the building, and 13 for the Archangel. Due to the changes in natural lighting conditions during the survey, the resulting raw data presents some unpleasant colorimetric defects, coupled with geometric errors (i.e. erroneous points related to the presence of persons and vehicles, flying points or noise inherent to the acquisition device). Manual processing is laborious and very time-consuming. A specific and automated processing pipeline has therefore been developed and applied to correct all these problems.

To create or complete elevations and plans, or to extract details and measurements, a specialized software has been developed to manipulate the large amount of 3D data, inherent of 3D scanner acquisitions of complex building, and to present the data as an enriched 2D representation for architectural and archaeological purpose. This is similar to orthophotos complemented by the possibility to navigate in the depth (e.g. to see an object and behind it) and to vary the rendering mode (including color, intensity, orientation), to highlight elements (like surfaces, edges or small details) hardly visible in simple color mode of rendering.

Its functionalities allow to realize very precise elevations and to generate projection images in high definition of all building parts and of the archangel statue. Indeed, this survey allowed us to draw the statue in its entirety to the real scale and in a completely proportioned way. For the Archangel, we have been able to distinguish the main components of the work and to better understand the articulations between its constituting parts and the various transformations made to the metal statue over the centuries.

Jona SCHLEGEL | Kelly GILLIKIN | Arie KAI-BROWNE | Thomas SCHENK, Austria

A digitally reconstructed Roman marketplace disintegrates

Keywords: geophysical prospection, image-based modeling, virtual archaeology, reconstruction, aging process

Abstract: 2016 and 2017 students of the University of Applied Science Berlin and the Süleyman Demirel University collected 12 ha of geomagnetic data and 0,5 ha of ground penetrating data and took around 10,000 pictures for image-based modeling at an ancient mound fortification in Central Anatolia (Turkey). The selected area for a detailed reconstruction and visualization of the decay process is a Roman delicacies market (Macellum), located at the archaeological site of Seleukeia Sidera. Various methods produce multiple types of data from the area. An intensive field survey provides data for a rough temporal classification. Geomagnetic measurements yield a position of features and offer insight into the material properties. Ground penetrating radar data provides information about the dimensions as well as the depth of the features under the surface. Image-based modeling creates an extremely accurate topographical model. With this data a detailed current state of the documented area is mapped. These results provide a basis for a visualization of the Macellum, whereby neighboring sites such as Sagalassos and knowledge of Roman construction style also influence the recreation of the architectural design. The resulting digital model and interpreted results from geophysical and topographical data are artificially aged over a period of 2000 years. The properties of the building materials and the environmental conditions at the site are used for the simulation of the decay process. First of all, the market is visualized at various stages, showing the different aging states. Then diffuse, normal and specular maps are used to create the appropriate textures. Finally, the model is loaded after its reconstruction in a game engine and a shader used to visualize its different states. This poster presents a pipeline of data collection, processing and presentation using state-of-the-art, innovative visualization methods.

Francesca SOLINAS | Luca ALBERGONI, Italy

The Bellini's Museum Gallery: from tradition to present time using digital documentation

Keywords: Florence 3DLaserScanner 3DPhotogrammetry VirtualTour360°

Abstract: The Bellini Family has been one of the most prestigious Florentine antique collectors and since the seventeenth century to the present time. Their gallery is aimed to preserving the collections in the wake of the great Florentine Case Gallerie antiquarie (galleries and auction houses) that arose between the 19th and the 20th centuries therefore witnesses the Florentine historical legacy. Located in Lungarno Soderini the museum overlooks Ponte alla Carraia. In modern times it has undergone various reworkings before adopting the current configuration through the work of the architect A. Coppedé.

The analysis of the building moves from a historical and cartographic research on archive sources and it relies on bibliographies. It has been articulated in two survey campaigns which involved the use of the 3D photogrammetry and 3D Lasers Scanner. Following a specific request by prof. Bellini, a subsequent campaign was furthermore carried out using a 360 ° panoramic video-photography of the galleries on the two levels of the building,

At a later stage the collected data have been processed to obtain a three-dimensional texturized

reconstruction of the main elevation, and the cloud of points of the entire building.

This has been followed by the restitution of the high resolution orthophoto of the façade and of the geometric survey of the structure, with the identification of its material characteristics and critical situations.

In the final phase of the project hypotheses of intervention are proposed to respond to regulatory requirements, maintaining and enhancing the two current functions of the building: the contemporary art gallery and the antique gallery.

Boris STUMMER, Austria

3 D Laserscan in Lower Austria

Keywords: Laserscanning 3D Modelle

Abstract: A cooperation between the Department of Art and Culture and the Department of Hydrology and Geoinformation of the Office of the Provincial Government of Lower Austria.

Since 2006 the latest 3D surveying methods are used in Lower Austria for documentation of excavations, buildings and objects. From various viewpoints the objects and surfaces are scanned line by line by a laser-impulse from a terrestrial laserscanner.

To link these scanner created point clouds (from different viewpoints), pass points are measured with common measurement methods such as GPS or terrestrial surveying.

The tested measuring systems have an additional, integrated digital camera to take pictures of the object from each scan position. With this photo assisted point cloud, an almost complete 3D presentation (image) of the object surface can be created (shown).

In post-processing of the recorded data, 3D models are generated which portray reality with high detail. The further processing of the 3D models depends on the asked requirements.

Since 2007 a database allows access to the steadily growing archaeological stock of the nationwide collection of Lower Austria. For scientific editing and web presentation, the database provides the original geometry, an optimized model and all available attribute data of the discovered objects.

The basis is built by the capture of the (object data) objects geometry by laserscan. The high measuring accuracy in the submillimeter range complies with the fine structural information of the discovered object.

After the actual capture of the measurement data, a geometric model is generated and coupled with digital photography which covers the object completely.

By generating the model the distinction being made between data gaps and malposition of the objects is essential.

Marco TANGANELLI | Giorgio VERDIANI | Raffaella PAOLUCCI, Italy

Great statues and seismic vulnerability, a photogrammetric approach for early safeguard

Keywords: Photogrammetry, Statues, Bargello Museum, Seismic Vulnerability, Resilience

Abstract: In recent years, more and more attention has been paid to creating safeguards measures in protecting masterpieces, art items, large statues, from the uncontrollable event of an earthquake. In the poster presented here a specific research about this subject will be brought to the attention of the conference participants: It will be shown how, from a set of significant statues from the Bargello

Museum in Florence, Italy, it is possible to define a working model for simulating the effects of an earthquake and understand the real state of safety of these artworks. While the correct definition of the shape of the elements is fundamental in this processing, a particular attention will be given to the phase of digital survey, here operated using photogrammetry based on Structure from Motion procedures. All the steps of the workflow will be analyzed and described in its main issues, lessons learned, new procedures. A set of different procedures will be compared, a speeditive method based on a smartphone camera and quick and simple modeling to one based on a 50 Mp resolution camera with high quality optic and highly accurate modeling. The result of the two procedures will be matched to the results of the simulation analysis, suggesting affordable approaches for any similar conditions about the interpretation of the state of safety of this important cultural heritage.

Richard THOMA, Austria

SFM - Structure from Motion

Keywords: SFM 3D photos documentation visualisation

Abstract: Structure from motion (SfM) is a photogrammetric range imaging technique for computing three-dimensional structures from two-dimensional image sequences that may be coupled with local motion signals. To find correspondence between images, features such as corner points (e. g. edges with gradients in multiple directions) are tracked from one image to the next. Correspondences tracking is based on multiple - mostly matrix-addicted - algorithms.

The method provides accurate and comprehensive 3D-documentation of any object when a sufficient sample of photos has been taken at different angles and - likely - similar light setting. Scale does not matter, from a small artefact to large excavation areas SFM can provide (supplementary) documentation data. Due to the highly detailed 3D-content many forms of visualisation are offered. Result of the computed data is an excellent 3D-Point-Cloud which can be evaluated both by exact (and georeferenced) measurement and archaeological interpretation.

In addition to the implementation in CAD-software, the export for GIS, 3D-visualisation-software or 3D printing stations is also possible. 3D-PDF ensures rendering and working with the data without additional, proprietary software.

Necessary equipment such as camera and total station are already available at most archaeological excavations.

Low additional costs on site - adding most detailed information of the object.

If enough images are available, even destroyed objects from the past can be documented in hindsight. According to sufficient photographic heritage even "historic" excavations can be computed.

As shown in the poster as case study the documentation of „Terrasse 7“ of „Schloß Hof“, a part of the baroque garden area, an complete 30 meter long baroque wall could be calculated from a sample of 120 photos. With the 3D-model the structure of the wall building can be investigated, measured and interpreted.

Rodrigo TISI | Diego PINOCHET, Chile

Museography and performativity: installing the space-time of Alero de Taira

Keywords: Rupestry Art, Atacama Desert, Immersive Experience, Space Storytelling, Spatial Installation

Abstract: Rock art is one of the oldest testimonies of humanity. It expresses our ability to think and capture through different types of representations: drawings and diagrams, the world we perceive, have and desire. This art, which literally records images on rocks has a spectacular landscape to look at in Chile, the Loa River canyon. This is how Alero de TAIRA becomes a unique outdoor art gallery in the Atacama Desert. The challenge of the exhibition was not only to present stories and archaeological objects that are significant of the past, but also to give an account of the physical location in which this heritage is located. The exhibition was developed with an immersive design that had the challenge of building the place and context where this rock art of TAIRA is located, and where its landscape and its people come together. In a way, the challenge was to "transport" the space-time of the Alero de TAIRA to the halls of the museum in Santiago, using state-of-the-art audiovisual and technological resources. The exhibition required doing what is generally understood in an exhibition of this nature, organizing a narrative script from several different found objects, to develop the archaeological focus that brings the content of the show. The design also considered a series of ethnographic records that incorporated human testimonies that became symbolic discourses on its own. The use of several media; video, audio and 3D animation and modeling (made with photogrammetry) allowed us to also produce the "TAIRA" app, which can be downloadable to a cell phone (IOS and Android). The audiovisual and interactive media resources served us to build an effective high-definition space for the viewer's joy and experience. It also served to push the "static" content of archaeological objects to a more complex and dynamic whole.

References:

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Nina TOLEVA-NOWAK | Wiktor NOWAK, Bulgaria

An Innovative Approach towards Preservation of Tangible Cultural Heritage Issues through the Lens of the Public Relations

Keywords: tangible heritage, problems and challenges of preservation, innovative approaches in preservation, visual communication-based approach

Abstract: The preservation of cultural heritage has a long history and vast theoretical background. Yet its current issues are more challenging and some of its contemporary approaches - more controversial. The biggest risk factors for the tangible heritage are war-related destruction, damage done by the intensified cultural tourism, demolition and inadequate treatment due to accelerating urban and infrastructural development, owners' reluctance in taking proper and sufficient care for the monuments due to heavy administrative procedures and high costs for maintenance and renovation. These problems have a common denominator - the inability of the public and the stakeholders to recognize the ephemeral importance of the tangible heritage as an external common memory, as a valuable testimony and material proof for past events. This inability is rooted in the lack of available

and sufficient public information about the monuments, especially those of local importance. Thus their physical evolution and the development of their adjacent environment in the urban context are doomed to oblivion as the scarce information is often either too hard to get and/or too expensive to reach.

Our innovative communication-based preservation approach aims at bringing closer the audience and the tangible heritage with the methods of the public relations and the tools of crisis communication - addressing issues on the professional and nonprofessional level, by small personal interventions, by raising an open and honest discussion, by presenting the true value of the built heritage as an irreplaceable bearer of information. By visualizing the effects of the compromised fabric of the cultural heritage as erased pieces of people's own personal memories, we aim to raise awareness of the importance of the everyday preservation, to educate broader and more informed audience, to foster a higher sensitivity towards public memory issues, in order to pass our history and our memories to future generations.

Giorgio VERDIANI | Stefano BERTOCCHI, Italy |Alessandro CAMIZ | Zeynep CEYLANLI | Muge SEVKETOGLU, Turkey

The Kyrenia Castle, an approach for digital documentation in North Cyprus

Keywords: Digital Survey, Integrated Survey, Kyrenia Castle, 3D Laser Scanner, Photogrammetry

Abstract: Documenting with an accurate survey a large architecture is nowadays a possible and affordable work, based on a mix of active and passive solutions, the use of digital survey tools offers extremely versatile opportunities of documentation no matter the extension of the building. In the poster presented here, a mix of Terrestrial and Aerial Photogrammetry and Terrestrial Lasergrammetry is used by academics in the context of the Kyrenia Castle in North Cyprus, a large medieval fortification almost organized in a square planimetry with a side of about 150 meters and walls height up to about 30 metres, gathering the occasion of a specific workshop (activated for one week in May 2018) and producing the first (partial) digital model of this large built heritage. Following the protocols and best practice in digital documentation of this kind of architectures -the coordinator group of the workshop in synergy with the management unit of the museum hosted in the castle- has brought on an articulated experience moving from the morphology of the castle, to its stratigraphy, to its exhibition aspects, to its restoration issues, to the production of multimedia contents for technical and/or general public access. In this poster it will be presented the structure of the workshop, the structure of the survey, the interactions and integrations between different surveys, the system of tools and the results coming out at first, from the on-field operations brought on by the students participating to the workshop and the following processing operated by technical expert operators. Going on to the development of common digital bases to evolve the way of approach to these monumental structures. The complete workflow with samples and QR-Code links to online resources will made of this poster a useful base for sharing and discussing the whole set of activities completed on this subject.

Rojin VISHKAIE, USA

Large Augmented Digital Displays for Interactive Experiences of Historic Sites

Keywords: Large Interactive Display, Augmented Experiences, Interactive Experiences, and Historic Sites

Abstract: This research project aimed at designing large, interactive displays for the Cathedral grounds of St Andrews, Scotland to enhance the visitors and librarians' experience by presenting maps also to discover more about the cathedral, the town of St Andrews, and its historical heritage. As part of this research project, we conducted interviews and focus groups with twenty visitors and librarians at the St Andrews' special collections to understand: what do users want to do with the special collections; is what users want to do with the special collections already possible with the current technology; how do users currently interact with the special collections; how do users engage with the special collections; and to explore what users see as potential uses for integrating special collections in digital displays' applications.

By providing a tested set of design specifications for the special collections and interactive digital displays, this research project will have a significant impact on the future improvement of applications and systems that support and augment interactions with the special collections.

In this research project, we applied the contextual design and ethnographic approaches to collect data as the base criteria for deciding what the system should do and how it should be structured.

Vladan ZDRAVKOVIC, Serbia

Early-Christian pilgrimage centers – Spatial and architectural 3D Study of the sacral topography in 6TH century urban environment

Keywords: 3D Study, Visualization, pilgrimage

Abstract: A long-term Project of 3D Visualization of Caričin Grad – Justiniana Prima has started in 2002 as project that follows annual archaeological researches at Caričin Grad archaeological site, maintained by the Institute of Archaeology in Belgrade and University of Strasbourg / French School in Rome. Three phases of this Project were supported by the Romano-Germanic Museum in Mainz – RGZM, 2010, 2012 and 2017 . Within the same institution in Mainz and with support of Leibniz Society, a large “Pilgrimage Project” was achieved 2012-2015, within which 3D Architectural studies were accomplished for two early-Christian pilgrimage centers – Abu Mena near Alexandria and Holy Sepulcher in Jerusalem.

Following recent finding of three yet unexplored basilicas in Lower town of Caričin Grad that were evidenced by geo-radar, Caričin Grad could be joined to the group of urban agglomerations with arranged pilgrimage center at one part of its urban core. All three pilgrimage centers although differs from each other by the level of significance for the Christian oecumene, if analyzed as specific urban spatial agglomerations – newly erected town, ancient urban center and gradually developed pilgrimage settlement, share certain urban-architectural features which are caused by their sacral content primarily. Each of these pilgrimage complexes functioned differently when liturgy and ecclesiastical rituals are involved – Holy Sepulcher or Eusebius's “Church of Resurrection” was organized as peripatetic church complex, martyrion complex in Abu Mena in its greatest phase comprehend tripartite church complex gradually erected above Saint's tomb while in Caričin Grad

entire east portion of the walled Lower town was dedicated to the pilgrimage center of Justiniana Prima, anchored with its martyrion basilica within the group of four other basilicas, all different in primary structure and size.

Different solutions in urban planning, caused by the topography, already existing urban tissue and necessities for smoothly conveying of the entire pilgrimage routine, reflected in architectural solutions as well, where we could trace different approaches in design of the outer appearances of sacral spaces but similarities in organizing interiors of the church edifices.

EUROGRAPHICS GRAPHIC AND CULTURAL HERITAGE SYMPOSIUM

Organization Eurographics GCH

The following people will contribute to the organization of the GCH 2018 track of Visual Heritage 2018:

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Stanco Filippo

Weinmann Michael

Weyrich Tim

Ynnermann Anders

Zambanini Sebastian

Tutorial - Hands on Aioli, a reality-based 3D annotation platform for the collaborative documentation of CH artefacts

Organiser: Livio De Luca, Manuel Adeline, Alaoui M'Darhri Anas, Pamart Anthony, Abergel Violette, France

Archaeologists, architects, engineers, materials specialists, teachers, curators and restorers of cultural property, contribute to the daily knowledge and conservation of heritage artefacts. The management of multi-dimensional and multi-format data introduces new challenges, in particular the development of relevant analysis and interpretation methods, the sharing and correlation of heterogeneous data among several actors and contexts, and the centralised archiving of documentation results. Despite their different approaches and tools for observation, description and analysis, the actors of cultural heritage documentation all have a common interest and central focus: the heritage object, the physical one, whether it is a site, a building, a sculpture, a painting, a work of art, or an archaeological fragment. This is the starting point of Aioli, a reality-based 3D annotation platform, which allows a multidisciplinary community to build semantically-enriched 3D descriptions of heritage artefacts from simple images and spatialised annotations coupled with additional resources. Developed by the CNRS-MAP Lab, this platform introduces an innovative framework for the comprehensive, large-scale collaborative documentation of cultural heritage by integrating state-of-the-art technological components (fully automatic image-based 3D reconstruction, 2D-3D spreading and correlation of semantic annotations, multi-layered analysis of qualitative and quantitative attributes, ...) within a cloud infrastructure accessible via web interfaces from PCs, tablets and smartphones online and onsite. Aioli introduces an original informative linkage between the physical object space and its digital representation by integrating:

- An incremental image-based 3D spatialisation process to manage the geometric merging of several images coming from different actors at different temporal states;
- A 2D/3D annotation framework enabling users to draw, visualise and register relevant surface regions by handling simple 2D images spatially oriented around a dynamic 3D representation;
- A multi-layered morphology-based data structuring model to accurately describe real objects in all their geometric complexity and according to multidisciplinary observations.

Further information on: www.aioli.cloud/en/

By merging the presentation of features with the manipulation of real data, this tutorial allow participants to discover the platform, its potential uses, as well as the basic commands to collect, process, analyse, structure and share data. Envisaged schedule: First part (80 minutes) – Basic principles & general approach – Projects management (personal account, collaborators, sharing options, ...) – Acquisition protocols (incremental image-based 3D spatialisation process) Coffee break (20 minutes) Second part (80 minutes) – Multi-layered 2D/3D annotation – Data structuring (layers, attributes, values, file attachments, ...) – Sharing results

SESSIONS

Scanning for Cultural Heritage

Martin RITZ | Martin KNUTH | Pedro SANTOS | Dieter FELLNER, Germany

CultArc3D_mini: Fully Automatic Zero-Button 3D Replicator

Abstract: 3D scanning and 3D printing are two rapidly evolving domains, both generating results with a huge and growing spectrum of applications. Especially in Cultural Heritage, a massive and increasing amount of objects awaits digitization for various purposes, one of them being replication. Yet, current approaches to optical 3D digitization are semi-automatic at best and require great user effort whenever high quality is desired. With our solution we provide the missing link between both domains, and present a fully automatic 3D object replicator which does not require user interaction. The system consists of our photogrammetric 3D scanner CultArc3D_mini that captures an optimal image set for 3D geometry and texture reconstruction and even optical material properties of objects in only minutes, a conveyor system for automatic object feed-in and -out, a 3D printer, and our sensor-based process flow software that handles every single process step of the complex sequence from image acquisition, sensor-based object transportation, 3D reconstruction involving different kinds of calibrations, to 3D printing of the resulting virtual replica immediately after 3D reconstruction. Typically, one-button machines require the user to start the process by interacting over a user interface. Since positioning and pickup of objects is automatically registered, the only thing left for the user to do is placing an object at the entry and retrieving it from the exit after scanning. Shortly after, the 3D replica can be picked up from the 3D printer. Technically, we created a zero-button 3D replicator that provides high throughput digitization in 3D, requiring only minutes per object, and it is publicly showcased in action at 3IT Berlin.

Mathijs VAN HENGSTUM | Tessa ESSERS | Willemijn ELKHUIZEN | Dimitra DODOU | Yu SONG Jo GERAEDTS | Joris DIK, The Netherlands

Development of a high resolution topography and color scanner to capture craquelure patterns of paintings

Abstract: The aging of paintings is inevitable and over the years degradation occurs due to exposure to a variety of environmental influences. One of these degradations is craquelure, fracture patterns in the paint. 3D imaging techniques offer opportunities to capture the surface of a painting and these patterns at high resolution. In this paper we present a 3D scanner that is able to capture surface topography and color of oil paintings at high resolution utilizing fringe-encoded stereo imaging scanning system. The scanner is capable of automated capture of an area of 1x1m², capturing a painting at a spatial resolution of 7 micron and a depth accuracy of 34 microns. Scanning at this resolution creates potential research opportunities for documentation and monitoring oil paintings under its environmental influences. A scan was made of 'Girl with a Pearl Earring' (c.1665), painted by Johannes Vermeer, which exhibits fine craquelure patterns. The scanner is able to capture the

painting of 39x44.5 cm within 2 hours with a tile overlap of 25%. The results showed that the craquelure has more often a ridge-shaped profile instead of the expected inward valleys. The documentation of these variations in crack profiles create interesting paths for future research.

Jan CEJKA | Marek ZUZI | Panagiotis AGRAFOTIS | Dimitrios SKARLATOS | Fabio BRUNO | Fotis LIAROKAPIS, Czech Republic | Cyprus | Italy

Improving Marker-Based Tracking for Augmented Reality in Underwater Environments

Abstract: Underwater sites are a challenging environment for augmented reality. Images taken under water are degraded in several ways, most importantly they are affected by unbalanced colors due to uneven absorption of light in each color channel, blurring and desaturation caused by turbidity, or noise due to the presence of larger organisms, plants, or bubbles. In this paper, we introduce a new method based on white balancing that enhances underwater images to improve the results of detection of markers. We compare this method with several image enhancement methods, and evaluate their performance when applied to the problem of detecting markers under water. Our results show that our method improves the detection in underwater environments while keeping the computation time low.

Francisco Javier MELERO | Jorge REVELLES | Maria Luisa BELLIDO, Spain

Atalaya3D: making universities' cultural heritage accessible through 3D technologies short paper

Abstract: This work was carried out over the past eight years through the Atalaya3D project, which aims to make the cultural heritage of the ten public Andalusian universities accessible. Since 2010, the project has been a pioneer in the field of 3D scanning of sculptures and historical sites, opening up restricted areas virtually through 3D web displays. Moreover, in addition to the website, a mobile app allows visitors to browse these institutions' vast heritage and examine it before visiting the campus in a 3D environment. More than 70 artworks and historical buildings have been accurately scanned using the latest 3D scanning technologies, so that we now have the geometry and colour of the pieces documented in detail. QR codes make it easier to reach the relevant information about our universities' heritage via any mobile device (phone or tablet).

VR in CH Applications

Ronan GAUGNE | Myrsini SAMAROUDI | Theophane NICOLAS | Jean-Baptiste BARREAU | Laurent GARNIER | Echavarría Karina RODRIGUEZ | Valérie GOURANTON, France | UK

Virtual Reality (VR) interactions with multiple interpretations of archaeological artefacts

Abstract: Increasingly, the incorporation of 3D printed artefacts into Virtual Reality (VR) and Augmented Reality (AR) experiences is of interest to Cultural Heritage professionals. This is because virtual environments, by themselves, cannot convey information such as the physical properties of artefacts within the environments. This paper presents a methodology for the development of VR

experiences which incorporate 3D replicas of artefacts as user interfaces. The methodology is applied on the development of an experience to present various interpretations of an urn which was found at the edge of a cliff on the south east coastal area of the United Kingdom in 1910. In order to support the understanding of the multiple interpretations of this artefact, the system deploys a virtual environment and a physical replica to allow users to interact with the artefacts and the environment. Feedback from heritage users suggests VR technologies along with digitally fabricated replicas can meaningfully engage audiences with multiple interpretations of cultural heritage artefacts.

Carlos ANDUJAR | Pere BRUNET | Jeronimo BUXAREU | Joan FONS | Narcis LAGUARDA | Jordi PASCUAL | Nuria PELECHANO, Spain

VR-assisted Architectural Design in a Heritage Site: the Sagrada Família Case Study

Abstract: Virtual Reality (VR) simulations have long been proposed to allow users to explore both yet-to-built buildings in architectural design, and ancient, remote or disappeared buildings in cultural heritage. In this paper we describe an on-going VR project on an UNESCO World Heritage Site that simultaneously addresses both scenarios: supporting architects in the task of designing the remaining parts of a large unfinished building, and simulating existing parts that define the environment that new designs must conform to. The main challenge for the team of architects is to advance towards the project completion being faithful to the original Gaudi's project, since many plans, drawings and plaster models were lost. We analyze the main requirements for collaborative architectural design in such a unique scenario, describe the main technical challenges, and discuss the lessons learned after one year of use of the system.

SELMANOVIC Elmedin | RIZVIC Selma | HARVEY Carlo | BOSKOVIC Dusanka | HULUSIC Vedad | CHAHIN Malek | SLJIVO Sanda, Bosnia and Herzegovina | UK

VR Video Storytelling for Intangible Cultural Heritage Preservation

Abstract: Interactive digital storytelling has become a popular method for virtual cultural heritage presentations. Combinations of stories and 3D virtual reconstructions are attractive for the audience and have high edutainment values. In this paper we investigate if 360° VR videos further contribute to user immersion in the preservation of intangible cultural heritage. It describes a case study of the Mostar bridge diving project, aimed to present and preserve the bridge diving tradition from the Old Bridge in Mostar, Bosnia and Herzegovina. It is a virtual reality application which enables the user to virtually jump off the bridge after watching 360° video stories about its history and the bridge diving tradition and upon successfully completing the quiz evaluation of the knowledge gained from the stories. The user experience evaluation study shows that our method was successful in preserving a form of intangible heritage and posits suggestions that can be used in developing an intangible heritage preservation framework.

3D Reconstruction for CH

Arnaud BLETTERER | Frédéric PAYAN | Marc ANTONINI | Anis MEFTAH, France

Towards the reconstruction of wide historical sites : A local graph-based representation to resample gigantic acquisitions

Abstract: Nowadays, LiDAR scanners are able to digitize very wide historical sites, leading to point clouds composed of billions of points. These point clouds are able to describe very small objects or elements disseminated in these sites, but also exhibit numerous defects in terms of sampling quality. Moreover, they sometimes contain too many samples to be processed as they are. In this paper, we propose a local graph-based structure to deal with the set of LiDAR acquisitions of a digitization campaign. Each acquisition is considered as a graph representing the local behavior of the captured surface. Those local graphs are then connected together to obtain a single and global representation of the original scene. This structure is particularly suitable for resampling gigantic points clouds. We show how we can reduce the number of points drastically while preserving the visual quality of large and complex sites, whatever the number of acquisitions.

Echavarria Karina RODRIGUEZ | Myrsini SAMAROU DI, UK

Digital workflow for creating 3D puzzles to engage audiences in the interpretation of archaeological artefacts

Abstract: 3D physical puzzles are typically used to engage audiences in the interpretation of archaeological artefacts in a museum exhibition. The reason for this is that a puzzle can be seen as a game but also as a complex activity that archaeologists undertake to re-assemble fragments. The contribution of this paper is a novel digital workflow for the design and fabrication of 3D heritage puzzles. The input to the workflow is an authentic artefact from a heritage collection, which is then digitised using technologies such as 3D scanning and 3D modelling. Thereafter, a puzzle generator produces the 3D puzzle pieces using a cell fracture algorithm and generates a set of puzzle pieces (female) and a single core piece (male) for fabrication. Finally, the pieces are fabricated using 3D printing technology and post-processed to facilitate the puzzle assembly. To demonstrate the workflow, we deploy the proposed method to create a 3D puzzle of an artefact, the Saltdean urn, for the Archaeological Gallery of the Brighton Museum and Art Gallery. The significance of this research is that it eases the task of creating puzzle-like activities and maintaining them within a busy museum gallery.

Ruggero PINTUS | Tinsae Gebrechristos DULECHA | Villanueva Alberto JASPE | Andrea GIACHETTI | Irina Mihaela CIORTAN | Enrico GOBBETTI, Italy

Objective and Subjective Evaluation of Virtual Relighting from Reflectance Transformation Imaging Data

Abstract: Reflectance Transformation Imaging (RTI) is widely used to produce relightable models from multi-light image collections. These models are used for a variety of tasks in the Cultural Heritage field. In this work, we carry out an objective and subjective evaluation of RTI data visualization. We start from the acquisition of a series of objects with different geometry and appearance characteristics

using a common dome-based configuration. We then transform the acquired data into reliable representations using different approaches: PTM, HSH, and RBF. We then perform an objective error estimation by comparing ground truth images with relighted ones in a leave-one-out framework using PSNR and SSIM error metrics. Moreover, we carry out a subjective investigation through perceptual experiments involving end users with a variety of backgrounds. Objective and subjective tests are shown to behave consistently, and significant differences are found between the various methods. While the proposed analysis has been performed on three common and state-of-the-art RTI visualization methods, our approach is general enough to be extended and applied in the future to new developed multi-light processing pipelines and rendering solutions, to assess their numerical precision and accuracy, and their perceptual visual quality.

Visualization and Visual Analytics for CH

Vanessa LANGE | Philipp KURTH | Benjamin KEINERT | Martin BOSS | Marc STAMMINGER | Frank BAUER, Germany

Proxy Painting

Abstract: For archaeologists it is often desirable to present statues in their original coloration. With projection mapping real-world surfaces are augmented by digital content to create compelling alterations of the scene's visual appearance without actually altering or even damaging the object. While there are frequent advances in projection quality, content creation is still a challenging and often unintuitive task, especially for non-experts. In our presented system we combine the advantages of digital content creation such as rapid prototyping with the convenience of an analog workflow. Users paint on smaller versions of the projection mapping target, employing real-world brushes and pencils, while the results are presented live on its large counter-part. We further demonstrate the integration of our system into a state-of-art game engine. By leveraging a powerful rendering and material workflow we make creating compelling materials and lighting situations an intuitive experience.

Bartosz BOGACZ | Felix FELDMANN | Christian PRAGER | Hubert MARA, Germany

Visualizing Networks of Maya Glyphs by Clustering Subglyphs

Abstract: Deciphering the Maya writing is an ongoing process that has already started in the early 19th century. Among the reasons why Maya hieroglyphic script and language are still undeciphered are inexpertly-created drawings of Maya writing systems resulting in a large number of misinterpretations concerning the contents of these glyphs. As a consequence, the decipherment of Maya writing systems has experienced several setbacks. Modern research in the domain of cultural heritage requires a maximum amount of precision in capturing and analyzing artifacts so that scholars can work on - preferably - unmodified data

as much as possible. This work presents an approach to visualize similar Maya glyphs and parts thereof and enable discovering novel connections between glyphs based on a machine learning pipeline. The algorithm is demonstrated on 3D scans from sculptured monuments, which have been filtered using a Multiscale Integral Invariant Filter (MSII) and then projected as a 2D image. Maya

glyphs are segmented from 2D images using projection profiles to generate a grid of columns and rows. Then, the glyphs themselves are segmented using the random walker approach, where background and foreground is separated based on the surface curvature of the original 3D surface. The retrieved subglyphs are first clustered by their sizes into a set of common sizes. For each glyph a feature vector based on Histogram of Gradients (HOG) is computed and used for a subsequent hierarchical clustering. The resultant clusters of glyph parts are used to discover and visualize connections between glyphs using a force directed network layout.

Anja WUTTE, Austria

Data visualization of decoration occurrence and distribution. A comparative study of Late Egyptian funerary decoration in Thebes short paper

Abstract: Decoration in Ancient Egyptian funerary monuments represents an important part of the monuments layout. Beside scenes displaying the owner, scenes of daily life, fabrication, offerings and hieroglyphic texts are found. Not only topics of self-presentation but also decoration for the translation to the afterlife were predominant. Therefore, this paper suggests approaches to analyze distribution and occurrence of decorations of several ancient monuments of the same style, with data visualization and quantitative methods. As a case study ancient Egyptian funerary monuments of High Officials from the Late Period, twenty-fifth to twenty-sixth dynasty, were studied. The decorative scenes were categorized and tagged in terms of their content. The positions in the monument were highlighted and included in abstracted 3-dimensional models. This computational implementation offers users to search for decoration categories, highlight, locate and finally compare the position of a scene between the monuments. The visualized data include the position and orientation of a categorized scene in the monument, their occurrence and distribution among the analyzed monuments. In a further step the analysis data was studied statistically in order to be able to query detailed results of the prevalence, distribution and preservation of decorations and specific scenes. Both introduced solutions provide a user friendly information interface to visualize, compare and request quantitative data.

Virtual Museums and Virtual Documentation

Jorge CARDOSO | Andre BELO, Portugal

Evaluation of Multi-Platform Mobile AR Frameworks for Roman Mosaic Augmentation

Abstract: Augmented Reality (AR) development frameworks have different recognition performance on different kinds of target images. In this work, we studied AR frameworks applied in the context of outdoor Roman mosaic ruins with the final aim of developing a multi-platform mobile AR application. We started by analysing the documented features of existing frameworks to determine the feasible ones. This resulted in the selection of three frameworks: CraftAR, PixLive, and Wikitude. We then experimentally evaluated the performance of the target recognition features against real mosaics by measuring the recognition delay, minimum required target area, visual alignment and visual stability. Results indicate a good recognition rate for CraftAR and a poor recognition rate for Wikitude. CraftAR

showed better recognition delay and visual stability, while PixLive showed better minimum required target area and visual alignment.

Christina TSITA | Anastasis SINANIS | Nikolaos DIMITRIOU | Kostas PAPACHRISTOU | Anastasia KARAGEORGOPOULOU | Anastasios DROSOU | Dimitrios TZOVARAS, Greece

A configurable design approach for VR museums short paper

Abstract: Virtual Museums (VM) are widely used to preserve and to disseminate cultural heritage to the audience, due to the existing evidence that they can enhance the interest on cultural heritage content, while reinforcing motivation for a real museum visit. A variety of technologies are being used including Virtual Reality (VR), to display cultural heritage objects (CHOs) and related information, in order to offer enjoyable and immersive experiences to the visitors. Additionally, educational aspects of VMs are being explored, due to their inheritance from physical museums, which are educational institutions, among their other roles. Innovative approaches such as authoring tools for the creation of VMs have been introduced in order to fulfil the variant needs of field specialist, audience and educators. The diversity of contexts where a VM can be used, require the creation of open access tools to form customizable VMs for every need. This study aims to present a configurable design approach for the creation of VR museums. The goal is to disseminate the virtual artefacts and introduce them in an appealing way to the audience, the field experts and conservators, through VR experiences. The current version of the VM, allows the curators to dynamically insert objects in the virtual space along with their metadata and measurements derived from various scanning processes. The proposed design approach can support the structure of an open access platform for the creation of immersive VM exhibitions.

Renato DE DONATO | Massimo DE SANTO | Alberto NEGRO | Donato PIROZZI | Diletta RIZZOLO | Gianluca SANTANGELO | Vittorio SCARANO, Italy

A Social Platform to support Citizens Reuse of Open 3D Visualisations: a Citizen Science approach short paper

Abstract: There is a growing interest in the world of Open Data, with many initiatives in the Cultural Heritage field. Platforms like Europeana, archive.org, Open Heritage by Google are only few examples of on-line catalogues full of open artefacts published with various formats. It is a new and promising way to engage public, such as, students, citizens, non-profit organisations. This paper faces the question of how to help audience in reusing Open 3D models and other artefacts available on Open Cultural Heritage repositories. The idea is to provide a Social Platform named SPOD where citizens can visualise artefacts, share and comment with others in a social way to increase understanding, awareness and engagement in cultural heritage. The foundation is the Datalet-Ecosystem Provider (DEEP), an open source, extensible, scalable, and Edge-centric visualisation architecture to support reuse of visualisations of Open Data in Cultural Heritage. It consists of reusable, dynamic and interactive visualizations named datalets. It includes a variety of visualisations, charts, geographical maps and 3D visualisations. Datalets

can be generated and embedded in any web-page as well. SPOD exploits the DEEP architecture to support users within the platform in generating visualisations of Open artefacts, reuse and share them within discussions.

Josep Lluís FITA | Gonzalo BESUIEVSKY | Gustavo PATOW, Spain

Earthquake Simulation for Ancient Building Destruction short paper

Abstract: Research on seismic simulations has been focused mainly on methodologies specially tailored for civil engineering. On the other hand, we have detected a certain lack of this kind of tools for interactive cultural heritage applications, where speed and plausibility are the main requirements to satisfy. We have designed a tool that allows to parameterize and recreate real earthquakes in an accurate, but simple way. Furthermore, we have focused our efforts on those users without much technical experience in geology or seismic simulation, such as historians, art historians, museum curators and other similar stakeholders. We have performed a series of tests over a set of ancient masonry buildings such as walls with their respective battlements, houses and a Romanesque church with structural simulation enabled, thus, allowing the coupling between the earthquake being simulated and the objects of interest. We show the feasibility of including earthquake simulations and structural stability into historical studies for helping the professionals to understand better those events of the past where an earthquake took place.

Digital Documentation for Conservation

Irina Mihaela CIORTAN | G. MARCHIORO | C. DAFFARA | Ruggero PINTUS | Enrico GOBBETTI | Andrea GIACHETTI, Italy

Aging Prediction of Cultural Heritage Samples Based on Surface Microgeometry

Abstract: A critical and challenging aspect for the study of Cultural Heritage (CH) assets is related to the characterization of the materials that compose them and to the variation of these materials with time. In this paper, we exploit a realistic dataset of artificially aged metallic samples treated with different coatings commonly used for artworks' protection in order to evaluate different approaches to extract material features from high-resolution depth maps. In particular, we estimated, on microprofilometric surface acquisitions of the samples, performed at different aging steps, standard roughness descriptors used in materials science as well as classical and recent image texture descriptors. We analyzed the ability of the features to discriminate different aging steps and performed supervised classification tests showing the feasibility of a texture-based aging analysis and the effectiveness of coatings in reducing the surfaces' change with time.

Anastasia MOUTAFIDOU | Georgios ADAMOPOULOS | Anastasios DROSOU | Dimitrios TZOVARAS | Ioannis FUDOS, Greece

Multiple Material Layer Visualization for Cultural Heritage Artifacts short paper

Abstract: Material aging has a significant effect on the appearance of cultural heritage objects. These aging effects depend on material composition, object usage and weathering conditions but also on

physical and chemical substance parameters. Some types of changes in the materials underneath the visible layers can also be detected and subsequently simulated. Furthermore, recent 3D printing technology enables exporting 3D objects with transparency information. We report on the development of software tools for visualization of material aging for artwork objects that can be used by curators and archaeologists to understand the nature of aging and prevent it with minimal preservation work.

Willemijn S. ELKHUIZEN | Tessa T. W. ESSERS | Yu SONG | Sylvia C. Pont | Jo M. P. GERAEDTS
|Joris DIK, The Netherlands

***Gloss Characterization and Calibration for Material Appearance Reproduction of Paintings
short paper***

Abstract: Being able to link captured material characteristics and fabricable material appearance attributes is important for creating life-like reproductions. In this paper we propose a method for gloss calibration, and an approach for gloss gamut mapping, as part of an integrated approach for color, topography and gloss reproduction. For gloss calibration, gloss calibration targets were printed in the primary printing colors (CMYK and White), with uniform gloss in equal distant gloss levels. These targets were scanned using the proposed gloss scanner. To create the gloss gamut map, a monotonic curve was fitted to the mean gloss scan values at different gloss levels. Analysis of fitted curves indicated that the gloss mapping is independent of the diffuse colors. As a case study, the painting 'Fruit Still Life' by Cornelis de Heem was scanned, and the measured gloss was mapped to printable gloss levels using the relation described by the fitted curve. The printed result shows good correspondence to the painting's appearance, with clearly distinguishable gloss features for the in-gamut glass values.

Reinhold PREINER | Stephan KARL | Paul BAYER | Tobias SCHRECK, Austria

Elastic Flattening of Painted Pottery Surfaces short paper

Abstract: Generating flat images from paintings on curved surfaces is an important task in Archaeological analysis of ancient pottery. It allows comparing styles and painting techniques, e.g, for style and workshop attribution, and serves as basis for domain publications which typically use 2d images. To obtain such flat images from scanned textured 3d models of the pottery objects, current practice is to perform so-called rollouts using approximating shape primitives like cones or spheres, onto which the mesh surfaces are projected. While this process provides an intuitive deformation metaphor for the users, it naturally introduces unwanted distortions in the mapping of the surface, especially for vessels with high-curvature profiles. In this work, we perform an elastic flattening of these projected meshes, where stretch energy is minimized by simulating a physical relaxation process on a damped elastic spring model. We propose an intuitive contraction-directed physical setup which allows for an efficient relaxation while ensuring a controlled convergence. Our work has shown to produce images of significantly improved suitability for domain experts' tasks like interpretation, documentation and attribution of ancient pottery.

Tools for Multimedia or Museum Installations

Marco POTENZIANI | Marco CALLIERI | Roberto SCOPIGNO, Italy

Developing and Maintaining a Web 3D Viewer for the CH Community: An Evaluation of the 3DHOP Framework

Abstract: 3DHOP (3D Heritage On-line Presenter) has been released 4 years ago, as an open-source framework for the creation of interactive visualization of 3D content on the web, aimed at the CH field. Transforming a research tool into a software “product” usable by the heterogeneous CH community is not a simple task and requires a significant amount of resources plus a specific design. This work presents the evolution of the 3DHOP system, and the complex relationship with its community of users, made of content creators, CH experts and general public. We will discuss the new features introduced, as well as the design and implementation strategy employed to maintain the software and make it usable by developers. We will evaluate the effectiveness of the platform by illustrating some of the applications built with 3DHOP either internally or by external users, as well as by presenting the results of a survey aimed at gathering the opinions and suggestions of the user community.

Jean-Baptiste BARREAU, J. JOUINEAU, J. MÉRELLE, L. MailLard, Y. BERNARD, L. QUESNEL, France

Granitic recumbent statue reproduction by a seven axes robotic milling machine short paper

Abstract: Facing the sea, the rocks sculpted by the "Abbé Fouré" at the "Pointe du Christ" and the "Pointe de la Haie" in Rothéneuf (Brittany, France) attract many visitors. Winds, rains and sea spray erode each day a little more the sculptures carved in granite more than a century ago. In order to preserve the heritage, the "Association des Amis de l'Oeuvre de l'Abbé Fouré" tried to start an innovative project: recreate a statue sculpted by the "Ermite of Rothéneuf" at the end of the 19th century thanks to 3D technologies and robotics. With a first 3D scanning of the sculpture of the "Pointe du Christ", a stonecutters' company was approached to reproduce identically this recumbent statue, identified as John IV, Duke of Brittany. Thanks to a robotic milling machine working on seven axes, by cutting layers in the granite at each passage, the company realized 60% of the work in less than a month. Then, a sculptor of the company was responsible, from documents collected by the association, to give the granite block the features of the original recumbent statue. This replica is currently the centerpiece of several French exhibitions dedicated to the general public.

Florian NIEBLING | Jonas BRUSCHKE | Marc Erich LATOSCHIK, Germany

Browsing Spatial Photography for Dissemination of Cultural Heritage Research Results using Augmented Models short paper

Abstract: Both digital and physical 3D models of buildings as well as historical photographs of architecture are used for a wide range of needs, from research in humanities and information technologies, museum contexts and library studies, to touristic applications. Spatially oriented photographs play an important role in visualizing and browsing contemporary as well as historical architecture, starting with the ground-breaking Photo Tourism project. We present a technique to combine physical, 3D-printed models of buildings with spatially registered historical photographic

documents in a hand-held Augmented Reality (AR) environment. Users are enabled to spatially explore historical views of architecture by selecting photos from a collection of images, which are then utilized as textures for the physical model rendered on their respective mobile device. We compare different methods to spatially select photos registered to a physical model in hand-held AR.

Jonas BRUSCHKE | Florian NIEBLING | Markus WACKER, Germany

Visualization of Orientations of Spatial Historical Photographs short paper

Abstract: Historical imagery are an important basis for research in Digital Humanities (DH). Especially art and architectural historians rely on historical photographs that are provided by online media repositories. In general, querying those image repositories is based on metadata. Unfortunately, these are often incomplete, imprecise, or wrong, impeding the search process. Using photogrammetric methods to spatialize the historical imagery, keyword-based search is enhanced by time- and location-dependent browsing methods within a four-dimensional model. The interactive, spatial presentation and exploration of these images opens up new potentials to answer research questions related to art and architectural historical science. One important aspect of the work presented here is to provide visualization methods that present statistical information about image positions, and in particular camera orientations. In addition to heat maps, we present adaptations of methods from flow field visualization to enable the exploration of camera orientations in large numbers of photographic images.

David JOHN | D. HURST | P. CHEETHAM | H. MANLEY, UK

Visualising Dudsbury Hillfort: Using Immersive Virtual Reality to Engage the Public with Cultural Heritage short paper

Abstract: Whilst computer visualisation is an established method of presenting cultural heritage, the use of game engines to provide a full immersive virtual reality experience is less well developed. This research documents the development of a visualisation of an Iron Age hillfort using Unreal Engine together with LiDAR terrain data to create a fully immersive experience for the virtual visitor. The visualisation was evaluated by 36 members of the public. The results show a high degree of satisfaction with the visualisation and agreement with the results of other studies demonstrating significant differences between those new to and those familiar with virtual reality applications. The conclusion is that in combination, game engines and LiDAR are effective tools for creating engaging virtual heritage visualisations.

3D Scanning & Digitization

Florian LARDEUX | Sylvain MARCHAND | Petra GOMEZ-KRÄMER, France

Multi-Light Energy Map short paper

Abstract: We propose a model to represent quasi-flat objects, such as coins or amphora stamps. These objects are flat surfaces, meaning their length and their width largely exceed their height, and feature a distinctive relief. This relief characterizes the object and its perception is directly influenced

by the position of the object, the light direction and the viewer's direction. Our model is a single image representation containing the underlying structural variations of the object. This model, that we call 'Multi-Light Energy Map', is constructed out of several classic images taken with several illumination directions without computing the object's surface normals. We found a way to extract useful information out of this sequence of images and compile it into our map. We eventually explain how we can use this model in the case of image registration of ancient coins.

Simon BRENNER | Sebastian ZAMBANINI | Robert SABLATNIG, Austria

An Investigation of Optimal Light Source Setups for Photometric Stereo Reconstruction of Historical Coins short paper

Abstract: In this paper, we address the 3D reconstruction of historical coins by means of Photometric Stereo. We investigate the influence of the number and arrangement of lights to the reconstruction quality by comparing mean angular errors on 22 historical coin models. Our results demonstrate that 6 lights circularly placed at an optimal elevation angle do not show a significant loss of reconstruction quality compared to a full semispherical dome setup with 54 lights. This represents a considerable saving of acquisition time and system complexity when it comes to the mass digitization of historical coins.

Jiao PAN | Liang LI | Hiroshi YAMAGUCHI | Kyoko HASEGAWA | I Thufail FADJAR | Bra MANTARA | Satoshi TANAKA, Japan | Indonesia

3D Reconstruction and Transparent Visualization of Indonesian Cultural Heritage from a Single Image short paper

Abstract: Herein, we propose a method for three-dimensional (3D) reconstruction of cultural heritage based on deep learning, which we apply to the reliefs of the Buddhist temple heritage of Borobudur Temple, in Indonesia. Some parts of the Borobudur reliefs have been hidden by stone walls and are not visible following the reinforcements during the Dutch rule. Today, only gray-scale photos of those hidden parts are displayed in the Borobudur Museum. First, we reconstruct 3D point clouds of the hidden reliefs from these photos and predict the pixel-wise depth information for each of them using a deep neural network model. We then apply our stochastic point-based rendering mechanism to produce a high-quality visualization of the reconstructed point clouds. We have achieved promising visualization results that provide us with an intuitive understanding of the valuable relief heritage that is no longer visible to ordinary visitors.

Echavarria Karina RODRIGUEZ | Karin JANZON | Jonathan WRIGHT, UK

Participatory co-creation of public sculpture incorporating 3D digital technologies short paper

Abstract: This paper presents a interdisciplinary project between artists, civic groups, heritage organisations, technical experts and communities to co-create a piece of artwork for the community. Constellation is the name of the sculpture, and Jonathan Wright, its creator, used a co-creation approach to develop both the design and fabrication of the artwork. To be installed in the Hove Plinth in Brighton & Hove (UK) and commissioned by the Hove Civic Society, this sculpture was envisaged

as a celebration of the community's heritage. As such, the mechanical model was designed as a solar system and instead of planets, the most iconic heritage objects in the city were selected to orbit the system. In collaboration with communities, the artist selected these icons which were later 3D scanned in collaboration with technical experts and local heritage organisations. The icons were then manufactured using digital fabrication technologies, and installed in the sculpture. The inauguration of Constellation took place in April 2018 with very good reception from the public. Hence, this paper illustrates the advantages of co-creative approaches which incorporate digital technologies into their workflow.

Yu-Kun LAI | Echavarria Karina RODRIGUEZ | Ran SONG | Paul L.ROSIN, UK

An Image-based Approach for Detecting Faces Carved in Heritage Monuments short paper

Abstract: Heritage monuments such as columns, memorials and buildings are typically carved with a variety of visual features, including figural content, illustrating scenes from battles or historical narratives. Understanding such visual features is of interest to heritage professionals as it can facilitate the study of such monuments and their conservation. However, this visual analysis can be challenging due to the large-scale size, the amount of carvings and difficulty of access to monuments across the world. This paper makes a contribution towards this goal by presenting work-in-progress for developing image-based approaches for detecting visual features in 3D models, in particular of human faces. The motivation for focusing on faces is the prominence of human figures throughout monuments in the world. The methods are tested on a 3D model of a section of the Trajan Column cast at the Victoria and Albert (V&A) Museum in London, UK. The initial results suggest that methods based on machine learning can provide useful tools for heritage professionals to deal with the large-scale challenges presented by such large monuments.

Virtual Archaeology

Alexander REINHOLD | Ian GREGORY | Paul RAYSON, UK

Deep Mapping Tarn Hows: Automated Generation of 3D Historic Landscapes short paper

Abstract: Changing landscape presents a problem for both conservation and education at heritage sites. We consider the site of Tarn Hows in the English Lake District National Park, a site which has had significant landscape change over the past 200 years, from developing tree coverage, to the merging of three lakes into one. We created an automated process that combines an elevation map and a vegetation map to build a 3D representation of the landscape. We used this tool to create a 3D Deep Map of Tarn Hows, representing the site's landscape at multiple periods over time, allowing them to be viewed side by side and explored in an interactive environment. This 3D Deep Map provides an exploratory resource for site authorities to educate the public about the historic environment, with embedded multimedia in the application to provide additional information to users that might be disruptive or impractical to display on site. The 3D Deep Map also provides a tool for conservators to plan site maintenance to best maintain the integrity of the historic landscape without negatively impacting visitors' experience of the iconic site.

Roberto de LIMA | Toon SYKORA | Marleen De MEYER | Harco WILLEMS | Maarten VERGAUWEN, Belgium

On Combining Epigraphy, TLS, Photogrammetry, and Interactive Media for Heritage

Documentation: The Case Study of Djehutihotep's Tomb in Dayr al-Barsha short paper

Abstract: The governors' tombs located at Dayr al-Barsha are considered among the most important monuments of the Egyptian Middle Kingdom. Unfortunately, due to quarrying activities, looting, and natural catastrophes, the archaeological remains are now in a dilapidated state. Their documentation therefore becomes a necessary task towards the preservation and research of this provincial elite cemetery. Traditional geomatics-based heritage recording methods and sensors are, however, not sufficient to yield a full and comprehensive documentation. Inspired by emergent technologies, this paper proposes a symbiosis of digital epigraphy, Terrestrial Laser Scanning (TLS), image-based digitalization techniques, and 3D visualization platforms, to provide experts with a digital tool able to yield high-level information in terms of accurate digital drawings of decorated sections and dense 3D mesh models. Results show that the proposed approach provides a reliable alternative to answer research questions, especially in the context of ancient Egyptian heritage, as the level of detail captured enables the academic community to further explore decoration techniques, damage recognition, and digital reconstruction.

Alexander BORNIK | Mario WALLNER | Alois HINTERLEITER | Geert VERHOEVEN | Wolfgang NEUBAUER, Austria

Integrated Volume Visualisation of Archaeological Ground Penetrating Radar Data short paper

Abstract: The non-invasive prospection of our archaeological heritage is one of the main tasks of modern archaeology and often provides the necessary bases for further activities, such as special protection or intensified research. Geophysical prospections using ground-penetrating radar (GPR) are an invaluable tool for the non-destructive exploration of archaeological monuments still buried in the ground. However, the analysis and interpretation of the data sets generated in this way is a time-consuming and complex process and requires not only three-dimensional imagination but also a broad understanding of the archaeological remains. Therefore, understandable 3D visualisations are in great demand. This paper presents a novel integrated visualisation approach, which supports conjoint visualisation of scenes composed of heterogeneous data including GPR volumes and 3D models of interpretations and reconstructions. Visual depiction of relevant dataset areas and archaeological structures is facilitated based on flexible and localised visualisation techniques. Furthermore, the rendering system supports the computation of dynamic label layouts for scenes annotations.

Wolfgang NEUBAUER | Christoph TRAXLER | Lenzhofen ANDREAS | Matthias KUCERA, Austria

Integrated spatio-temporal documentation and analysis of archaeological stratifications using the Harris Matrix short paper

Abstract: The Harris Matrix (HM) is the fundamental diagrammatic representation of relative time for an archaeological site and the de facto standard for the representation of a stratigraphic sequence – the backbone for archaeological stratigraphy. It displays all uniquely identified units of stratification in a sequential diagram representing their relative temporal succession. The Harris Matrix Composer is a

widely used application in the archaeological community to efficiently create and analyse HMs. However, it does not support explicit dating of HM units, which is an important information for post-excavation investigations of an archaeological site. In this paper we describe an integrated approach for a combination of stratigraphic and chronologic relations. The implicit, chronologic sequence given by the HM becomes explicit as scientists are enabled to define a hierarchical time model and assign units of the HM to temporal intervals or provide exact dating. The system maintains a consistent visual representation, which means that a correct stratigraphic layout is preserved while units are aligned to intervals of the time model. Evaluation of a real-world use case showed that this combined visualisation makes the scientific analysis and interpretation more efficient and reliable.

Nemoto TAKASHI | Kobayashi TETSUYA | Oishi TAKESHI | Kagesawa MASATAKA | Kurokochi HIROMASA | Yoshimura SAKUJI | Zidan EISSA | Taha MAMDOUH, Japan | Egypt

Virtual Restoration of the Wooden Artifact under Non-Rigid Deformation: A Case of the First Solar Boat of King Khufu short paper

Abstract: In this paper, we present a method to digitally reassemble an object to its original form given the 3D data of its component which are assumed to be non-rigidly deformed. Targeting wooden artifacts, we developed an algorithm to deform the components parametrically, and constraints based on the physical properties of wood are imposed on the deformation. We apply our method to a deformed cultural asset, specifically the first solar boat of King Khufu which is made of wood.

Elihu RUBIN | Saima AKHTAR | Benedict BROWN | Holly RUSHMEIER, USA

New Haven Building Archive: A Database for the Collection, Study, and Communication of Local Built Heritage short paper

Abstract: The New Haven Building Archive (NHBA) is a digital, mobile, and interactive field guide to New Haven, Connecticut's built heritage. As an interactive digital guide and database for local buildings, the NHBA harnesses digital mapping technologies, place-based storytelling and community-based research. Ultimately, the development of the NHBA will aid in the co-production of knowledge about the city by students, academic researchers and local citizens in a way that will facilitate conversations about the historical patterns and future development of New Haven while suggesting a model for engaged teaching and research for urban studies more broadly.

Elia MOSCOSO THOMPSON | Silvia BIASOTTI | Giusi SORRENTINO | Martina POLIG | Sorin HERMON, Cyprus

Towards an automatic 3D patterns classification: the GRAVITATE use case short paper

Abstract: When cataloging archaeological fragments, decorative patterns are an indicator of the stylistic canon an object belongs to. In this paper we address a quantitative classification of the decorative pattern elements that characterize the models in the GRAVITATE use case, discussing the performance of a recent algorithm for pattern recognition over triangle meshes.

Andreas SCALAS | Valentina VASSALLO | Michela MORTARA | Michela SPAGNUOLO | Sorin HERMON, Cyprus | Sweden

Shape analysis techniques for the Ayia Irini case study short paper

Abstract: The typical approach for archaeological analysis is mainly qualitative and, as such, rather characterized by subjective reasoning and evaluations. Even when some measures are reported in the documentation of artefacts, they are often approximate or ambiguous: different archaeologists may measure very differently, and have no way to specify the exact procedure in their textual description. Conversely, the quantitative approach is based on objective metrics to produce replicable results and, coupled with digital tools, can assist the qualitative analysis in archaeological research with no risk of damage. In this paper, we present a geometric-quantitative approach for the analysis of archaeological finds and the preliminary results of an ongoing joint research project of two doctoral students within the frame of the EU GRAVITATE project.