

The Kyrenia Castle, an Approach to Digital Documentation in the Cyprus Island

STEFANO BERTOCCI and GIORGIO VERDIANI, University of Florence, Italy
ALESSANDRO CAMIZ and ZEYNEP CEYLANLI, Özyeğin University, Turkey
MÜGE ŞEVKETOĞLU, Cyprus International University, Cyprus Island

Documenting large architectures with an accurate survey has recently become possible even with a limited budget. Digital survey tools based on both active and passive solutions, offers today versatile opportunities for the architectural documentation, regardless of the building's dimension. This paper presents the poster, prepared for the CHNT conference, with an extract of Terrestrial and Aerial Photogrammetry and Terrestrial Lasergrammetry. This was used by academics in the context of the Kyrenia Castle in the Cyprus Island, a large medieval fortification organized in an almost square planimetry with a side of about 150 meters and walls height up to about 30 meters, 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 that poster it was 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. To present the complete workflow with samples the poster was enriched with QR-Code links to online resources has been made to be a useful base for sharing and discussing the whole set of activities completed on this subject.

Key words:

Digital Survey, Integrated Survey, Kyrenia Castle, 3D Laser Scanner, Photogrammetry

CHNT Reference:

Stefano Bertocci et al. 2018. The Kyrenia Castle, an Approach to Digital Documentation in the Cyprus Island.

INTRODUCTION

The Mediterranean area is undoubtedly rich of built heritage masterpieces, evident traces of human presences populate the territory since the time of the beginning of humanity [Blake and Knapp 2008], it offers an impressive view of architectures combined with the natural landscape.

The coasts, especially, present a rich set of ports, harbors [Franco 1996], fortifications and fortified towns, many of them developed from the XIII century, then reorganized in a significant way all along the XV and XVI centuries [Rodriguez-Navarro 2015; Verdiani 2016; Iribarren 2017; Avilés 2017; Marotta and Spallone 2018].

®

Author's address: Stefano Bertocci, Dipartimento di Architettura, Università degli Studi di Firenze, Piazza Ghiberti, 27, 50121, Firenze (FI) Italy, E-mail: stefano.bertocci@unifi.it; Giorgio Verdiani, Dipartimento di Architettura, Università degli Studi di Firenze, via della Mattonaia, 8, 50121, Firenze (FI) Italy, E-mail: giorgio.verdiani@unifi.it; Alessandro Camiz, Özyeğin Üniversitesi, Mimari Bölümü, Nisantep Mah. Orman Sok. No:34-36, 34794, Çekmeköy/Istanbul, Turkey, E-mail: alessandro.camiz@ozyegin.edu.tr; Zeynep Ceylanli, Department of Interior Architecture & Environmental Design, Özyeğin University, Nisantep Mah. Orman Sok. No:34-36, 34794, Çekmeköy/Istanbul, Turkey, E-mail: zeynep.ceylanli@ozyegin.edu.tr; Müge Şevketoğlu, Cyprus International University, Center for Archaeology, Cultural Heritage and Conservation, Haspolat 99040, Nicosia, Cyprus.

In recent times this well-known heritage entered a high-risk phase: the wrong restorations, the lack of proper culture, the minimal resources, the uncontrolled, speculative urban development, and the climate change [Sabbioni et al. 2008] caused dangerous condition for the fortified heritage.

From this perspective, beyond any strategy or intervention plan, the creation of proper culture and knowledge in students and professionals working in the field of architecture and cultural heritage is a priority and a task that may improve the approach to such a built patrimony. At the same time, the use of digital survey has proved to be an excellent way of documenting and later investigating and developing a project about built heritage.

These digital tools are nowadays more affordable, both in terms of costs and complexity of use. Many international experiences show how an intervention based on 3D Laser Scanner and additionally contemporary photogrammetry may allow to “bring at home” a whole large architecture and then post-process the data legitimately for articulated aims [Bertocci et al. 2014; Verdiani 2017; Guidi et al. 2009].

In the will of giving a contribution in preserving and creating a possible future to the fortified heritage, the organization of international workshops, mixing students, tutors and professors from different provenances, is a great opportunity to bring on proper dissemination and knowledge about how operating. [Camiz 2018]

A CASTLE THROUGH TIME

The number of castles along the Mediterranean coast is very large; together with the system of towers and minor fortifications they created a network for inspecting and controlling the movement of ships and people along and from the sea. In specific cases, they were simply keeping and protecting a waterway or a port.

In the case of the Kyrenia Castle, there is clearly a very articulated transformation through time, making the castle evolving accordingly to the evolution of weaponry and its passing by very different owners [Camiz et al. 2016; 2017].

The Kyrenia Castle represents three distinct periods of architectural development, as the techniques of warfare advanced from bows and arrows to the invention of gunpowder and cannons. Kyrenia Castle is one of the best examples to trace the evolution of medieval military castles in the region. The three periods traceable in the architecture of the fortifications are: Byzantine (330-1192 AD), Lusignan (1192-1472 AD) and Venetian (1472-1570 AD) [Enlart 1899]. The special position, with its strategic and practical importance, seems to be confirmed by the archaeological evidence besides the castle, Roman mosaics and Roman catacombs suggest the presence of earlier settlements dated about the 4th century AD.

The “Kyrenia Shipwreck”, the common name used to indicate the important finding of a ship from the 4th century BC in the waters in front of Kyrenia [Katzev 1981], also supports the idea about the presence of a busy port town. However, there is no evidence of a Roman military castle. This important relic is nowadays preserved inside the castle museum [Katzev 2008].

Today the castle, with its round towers, solidly built curtain walls, gun ports with smoke chimneys, and ramparts, represents one of the best architectural examples of the Venetian military architecture. Inside the castle in still well recognizable conditions there are prison cells, accommodation, and water cisterns created to provide support in case of siege. The drawbridge over a moat was the only way to access the castle. In the harbor remains of a chain tower are still in place; this was used to control incoming unwanted ships.

The gun ports facing the land are worth an explanation, their position comes from the fact that the attack was expected not only from the sea. Thus, even with such a series of defensive solutions, in 1571, Kyrenia Castle surrendered to the Ottoman army without firing a single shot [Hill 1948].

The Lusignan period castle entrance is visible after the end of the Venetian entrance rampart. The castle tower with its larger cut stones and coat of arms above the gate (placed during the British period) stands out from the Venetian period masonry work. The squared tower entrance of the Lusignan castle gate also had a portcullis. After the entrance a short tunnel suddenly turns left, this is a defence system in case the castle door gets broken, turning a blind corner and limiting the number of enemies to pass by and giving a better chance in pushing them back.

The North East tower of the Kyrenia Castle is still an intact Lusignan "horseshoe-shaped" tower with angled footing and loopholes for firing longbows [Jeffery 1935]. The Lusignans built the battlements for first, later the Venetians improved them, and so today they can be seen on the northern curtain wall. During this time, an enemy attack would

have used catapults instead of cannons. Ballista, crossbow, swords, and arrows were the most common artillery. Lusignan castle also had the Donjon or keep, which is today still partially visible and included in the museum exhibition. In its rooms King Peter's pregnant mistress was supposedly imprisoned by his jealous wife.

During the Lusignan period, the Kyrenia town where townsfolk resided and traded was a fortified town with its own towers acting as part of the castle fortification which was further enhanced by the Venetians and went out of use during the Ottoman period [Petre 2010].

The Byzantine castle is the first "castle" evidence in Kyrenia and its own remains, although fragmentary, can yet be traced. The main and prominent architecture from the Byzantine period is the chapel of St. George; originally built outside the Byzantine castle (and later outside Lusignan period castle). Venetians however, built their north-west tower enveloping it within the castle.

All the castle's stones were extracted from a nearby stone quarry named Chrysokava. The area was also used as an early Byzantine worship place.

THE STRUCTURE OF THE WORKSHOP

With the workshop in Girne/Kyrenia, "Reading and Designing the Kyrenia Castle" held in May 2018, an articulated group of participants from 30 different countries has faced the large Castle of Kyrenia. 56 students, 15 tutors, and 10 professors had the opportunity of considering this large castle from the point of view of the documentation, diagnosis, design and hypothesis of reuse and enhancement of its monumental apparatus. The approach to the subject was divided into three main tasks: the gathering of historical documentation, both from bibliographic sources and reading the evidences on site, the digital survey of the building with a specific attention to the museum areas, and the design intervention on the museum areas [Camiz, et al. 2018].

The aim of the workshop, coordinated with the Municipality of Girne and the Department of Antiquities and Museums, was to acquire data for the digital survey of the Castle and then to design a new archaeological museum inside the castle. For this survey time was extremely important, while the huge size of the building and the need to operate, teach and prepare/follow the post-processing and the preparation of the drawings/products coming from each scanning day was quite difficult. But it was possible to fix it in the mere time of one week.

The result was accomplished adopting an integrated survey, mixing the coverage from lasergrammetry with photogrammetry survey based on different sources; this allowed defining a quite complete and well exploitable coverage of the whole castle. The different teams collected a full 3D laser scanner survey of the central court and of its surroundings, a large set of aerial photogrammetric pictures by flying a small UAV, thousands of terrestrial high-resolution photographs, and a 3D eye complete imagery of the castle. The team of professors and tutors processed a part of the data collected on site during the workshop for teaching purposes.

Within the different activities brought on, one team documented with photographs and drawings the different types of masonries present in the castle for restoration purposes [Farre et al. 2019] and another team documented with terrestrial digital photogrammetric techniques some of the archaeological fragments in the castle [Attenni et al. 2019].

Exploiting these bases, the design teams proposed different solutions for a new exhibition area for the Kyrenia Ship relic and redesigned the showcases inside the existing museum to exhibit the collection of artefacts found during the underwater archaeological search for the Kyrenia Shipwreck. Hopefully, it would be very useful to acquire further funding for such a research project based for now only on the participants' goodwill, the possibility to move this museum to a next condition, emerged quite clearly from the work of the design group, a challenge that may found in the Kyrenia Castle a subject of great potential.

LASERGRAMMETRY

Since the very first planning of the workshop, it was decided to have a 3D Laser Scanner survey as the central element of all the measurement interventions. This choice was done because of some fundamental aspects: the 3D Laser Scanner is a fully trustable procedure, its use is easy to teach (and learn), the operative range of measurement and the many quality/density features combinations allow covering very large buildings in hours. The set of software to manage and move the point cloud datasets from visualization to CAD integration are easily accessible and

nowadays quite simple in their basic functions (so once again well suitable for teaching them in the short time of a workshop). Last but not least, the team of professors and tutors participating in the workshop was well experienced in using these tools and in planning operations in a timely manner.

The 3D laser scanner in use for this survey was a Zöller-Froelich Z+F Imager 5006h a phase-shift laser scanner capable to gather points at a distance up to 80 meters with an accuracy of about two millimeters on normal reflective materials. In the survey work of the Kyrenia Castle, for all the scans it was preferred to use settings with a density of points in “middle” mode (in this survey work this setting created single point clouds up to 9 million points) or “high” mode (in this survey work this setting created single point clouds up to 19 million points) and with an accuracy mostly set to “high” (with a redundancy of five for each measured point). In this way, each scan station asked about three to six minutes, plus the positioning times. Because of the quite high level of details and the possibility to have always articulated shapes with well recognizable characteristics, the use of targets to simplify and improve the alignment procedures was reduced to a minimal, using mostly paper “black and white” checkerboard targets. A logic of “reduction” of the occlusion spaces [Bini and Bertocci 2012] and of “support” to the following automatism in point-cloud alignments [Pomerleau et al. 2015], guided the planning of the survey strategy. In this way, it was possible to have short post processing times and fully descriptive results. The lasergrammetry survey covered the part of the castle from the main entrance up to the central court along the main passage and from there to the museum areas, the inner part of the northern tower, all the higher passages and the area of the Church. In five days, 257 scan stations were completed, gathering about 2.5 billion of points.

The needs of the workshop guided the post-processing strategy, starting from the second day of survey, one operator began to treat the datasets, checking them and bringing the alignment of each scan into a unique point cloud. In this way, each day of activity produced a single point cloud, furthermore treated by one of the groups of students. The area focusing of the groups was all around the museum area and the central court. So the survey work started from there and moved around for the first three days. The last two days of survey were mostly dedicated to sectors out of the planning/re-design studies, like the top parts with passages and the church.

The software in use for the post-processing of the 3D Laser Scanner data were *Autodesk Recap*¹ and *Bentley Pointools 8Vi*², two very practical tools, with *Recap* capable to accept directly the ZFS files from the Z+F unit, process them in fast, automatic (and easy to teach) mode and implement the point cloud data into other *Autodesk* software. Following the aligned point cloud was the base to produce some very basic references for the students group: vertical and horizontal sections, fronts, plan views, orthographic and perspective views of the castle. The views were selected accordingly to descriptive needs and following specific questions from the students and tutors. After the definition of the views, most of the time, the drawing was extracted in raster image mode, using the simplest solution for producing classic 2D drawings. All the 3D and advanced modelling were postponed for the researches foreseen as following steps of the workshop.

TERRESTRIAL PHOTOGRAMMETRY

In the last ten years, the renovation of photogrammetry has brought incredible advantages in all the disciplines. Nowadays the evolution of these tools is undoubtedly a great opportunity for any built heritage documentation. The growth in the use of these tools is evident and more and more the possibility of integration with GPS and 3D laser scanner data makes the use of photogrammetry strategic and efficient. The use of different dataset (3DLS, GPS, Images) is little by little moving to full integration, leaving the separation of tools/kind of surveys [Guidi 2014] like a past condition. The fast operations, good results, creating a model become as simple as taking pictures, for most of the students at the first use of this solution, the use of software based on SfM/IM procedures [Guidi and Gonizzi 2014] may look so simple and intuitive to appear like a kind of magic.

The automatization of the photogrammetry processing and the almost immediate generation of 3D models create sometimes the conditions for operating in a sort of “black box”. On one side the pictures enter and on the other the textured 3D model comes out. It looks like the renewed photogrammetry has inverted the satirical aphorism of Ambrose Bierce when in his “Devil’s Dictionary” he writes about the word “Picture”:

“A representation in two dimensions of something wearisome in three”.

[Bierce 1980]

¹ <https://www.autodesk.com/products/recap/overview>

² <https://www.bentley.com/it/products/product-line/reality-modeling-software/bentley-pointools>

Thus, it is clear that most of the issue about the quality of what is produced depends on the quality of the pictures. So, becoming a good photographer, at least from a technical point of view, with clear knowledge about photographic aspects and how they may affect the results from photogrammetry, is the most relevant step any student may take to start using conscientiously a camera to produce 3D models. Keeping the students out of this understanding is most of the case a poor choice.

The workshop had various photogrammetric activities, in many of them, the students were called to use and to get better experienced with their own cameras, while, at the same time, a set of professional pictures were taken by tutors and/or professors to create a solid completion of the digital documentation of the castle.

The photogrammetric works were divided by subjects and tools: one about all the external front of the Castle (using both a Nikon D800e full frame, 36.3 Mp DSLR with a 24-120 mm F4 Nikkor zoom lens and a 3D Eye kit with Sony Cyber-shot DSC-QX30 20.1 Mp camera, 10 meters pole and remote control); one about the relic of the ship in the Shipwreck room; one about the Graffiti in the Shipwreck room [Bertocci et al. 2019]; one about the church [Volzone et al. 2019], these three conducted using only the Nikon D800e with the Nikkor 24-120 mm F4 and a Micro-Nikkor 60 mm F 2.8; one about the single fragments around the main court, developed with various cameras [Atteni et al. 2019]. Moreover, some groups of students experimented the photogrammetry shooting and processing on some front of the central court, using their own equipment.

The photogrammetry processing was done partially in place, but most of all the accurate and final processing was postponed to the following phases. The problem to operate in place was connected mainly to the calculation time and the missing of a robust Internet connection. The first issue was something not possible to solve in the short time of the workshop, while the second issue was stopping any intention about uploading the pictures to some online service like the one provided by Autodesk Recap. Most of the photogrammetric processing was done using *Agisoft Photoscan*³, using a couple of well performant notebooks. Some testing using Reality Capture were done to allow the participant to see the different results, the computing times, the specific differences in the workflow from picture to the final 3D model.

The students got instructions about how to work correctly for terrestrial photogrammetry, details about their cameras and about the tools in use in the workshop (the characteristics and benefits of a professional high-resolution DSLR and of the 3D Eye kit). They got all the information about how to perform basic treatments of their images and 3D models to enhance the result, without going too much in details about an advanced solution for pre-processing of the pictures [Gaiani et al. 2016] and post-processing of the 3D models [Verdiani 2011].

AERIAL PHOTOGRAMMETRY

Taking pictures from the air is one of the most common need (and dream) in archaeological and in general in the external survey, the last years made it quite a common task in any well-structured intervention.

The easy access to UAV technologies and the marketing of more and more safe and simplified systems available “on the shelves” made possible to anyone the use of a “flying camera” [Gilli and Gilli 2016]. It is worth to say that such a condition meets the need of regulations and rules, so, the actual conditions for using this global innovation must accomplish to local and specific rules, authorizations and laws that are expected to be well known by the drone operators [Franke 2014].

In the case of the Kyrenia Castle, having a flight with a UAV unit was a great contribution in terms of completion and integration of the digital survey. Using a DJI Spark unit, equipped with a 12 Mp camera, the series of flights produced a sub-selection of 1303 usable shots, covering all the top parts of the walls and completing a massive, but well detailed 3D model of all the external parts of the castle and its near surroundings.

The operators started all the main flights from the central courtyard and from the top of the walls, some secondary flights were taken from the streets around the castle. The participants to the workshop were able to assist the operation and post-process various image sets taken from the UAV, obviously, it was not possible to have a “hands-on” experience in flight mode, but they got a well-detailed description of all the procedures and operational conditions.

³ <https://www.agisoft.com/>

DESIGN PROPOSAL

Three design teams worked in close contact with the lasergrammetry team since they provided the necessary cloud datasets of the whole structure to be transferred to CAD programs during the design process.

What had been given as a design problem was to re-evaluate the spatial characteristics of the castle and the existing museum section and come up with a proposal for an archaeological museum entirely dedicated to the Kyrenia Shipwreck [Katzev 1981], which holds an important place in the history of underwater archaeology [Katzev 2008].

All the teams approached the castle museum in different angles: the design program was set either comprehensively from the main entrance of the castle to the showcases for the artefacts with a separate temporary structure for the shipwreck or focused on the existing museum section to create an affordable real-time solution as a response to the request of the museum administration.

Both approaches acknowledged the changing characteristics of museums in terms of pedagogy, cultural production, economic appraisal, and social interaction where the museum is designed in consideration with the

“...*bodily, sensory and affective impacts of spaces and objects on visitors*”. [Tzortzi 2017, p. 495]

The design intervention was not conducted by the tutors and the students merely as a museum design exercise, but the means of understanding and promoting a cultural heritage was also examined throughout the workshop. One of the groups chose to introduce a novel architectural extension that goes through and constructs the whole visitor path.

The group working on the showcases highlighted the small artefacts that were revealed from the Kyrenia Shipwreck, depicting a physical attribution to what the casings exhibit specifically. Yet, another group defined the existing problems of the current exhibition and the physical inadequacies of the Kyrenia Castle Museum and came up with a practical yet inclusive design proposal, where the sixth one of the consequent rooms on the northeast side of the inner courtyard was to be rebuilt with a contemporary construction material to house the shipwreck [Ceylanlı et al. 2019]. The design proposals were brought on to a certain point where the administrative organs could have a perspective plan of executing a well-rounded museum for the sake of the castle, the shipwreck and the city of Girne.

CONCLUSIONS

The Kyrenia Castle workshop has been the occasion to establish an operative base of knowledge and to gather a significant amount of data about a Castle that represents a challenging monument in the Mediterranean scenario.

The first digitalization of this fortification is ought to be the starting point of a series of studies. This paper, following the poster brought in the CHNT/VH conference in Vienna in November 2018, presents the roadmap about the post-processing of the digital resources produced in the castle in the days of the workshop (Fig. 6).

If the workshop was the moment to disseminate and strictly collaborate, the following phases are the moments for reflections, in-depth researches, more accurate calculations, experiment and testing with different solutions.

Writing this research allows the development of a series of papers, describing the various activities and the specific experience and investigations centered on the Kyrenia Castle, as well as a series of master's and specialization theses about the development of an HBIM [Brusaporci 2015] of some part of the castle, the proposals for a new museum assets, an intervention plan about a set of strategic starting restorations and new approaches to the presentation of some valuable items inside the castle, like the Kyrenia Ship and the various Graffiti representing harbors, ships and boats.

The historical value of the subject and the technically advanced intervention, mixed with professional and academic competencies has brought to a high-quality teaching moment, even in the variety of proveniences, interests, approaches, the people involved in this experience have found a moment of measuring themselves with the importance of the monument, with his story.

A moment where Cultural Heritage and New Technologies have really found a common ground!



Fig. 1. View of the Kyrenia Castle from the harbour (foto: Neuwieser)

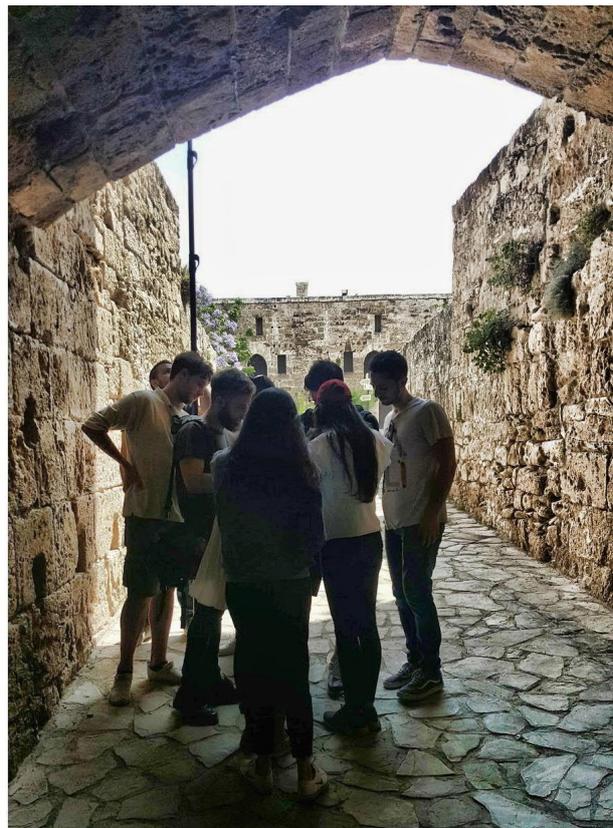


Fig. 2. A group of participants to the workshop working with the 3D Eye unit



Fig. 3. Operations with the drone on the walls of the Kyrenia Castle



Fig. 4. The aligned point-cloud from the 3D Laser Scanner survey in Autodesk Recap

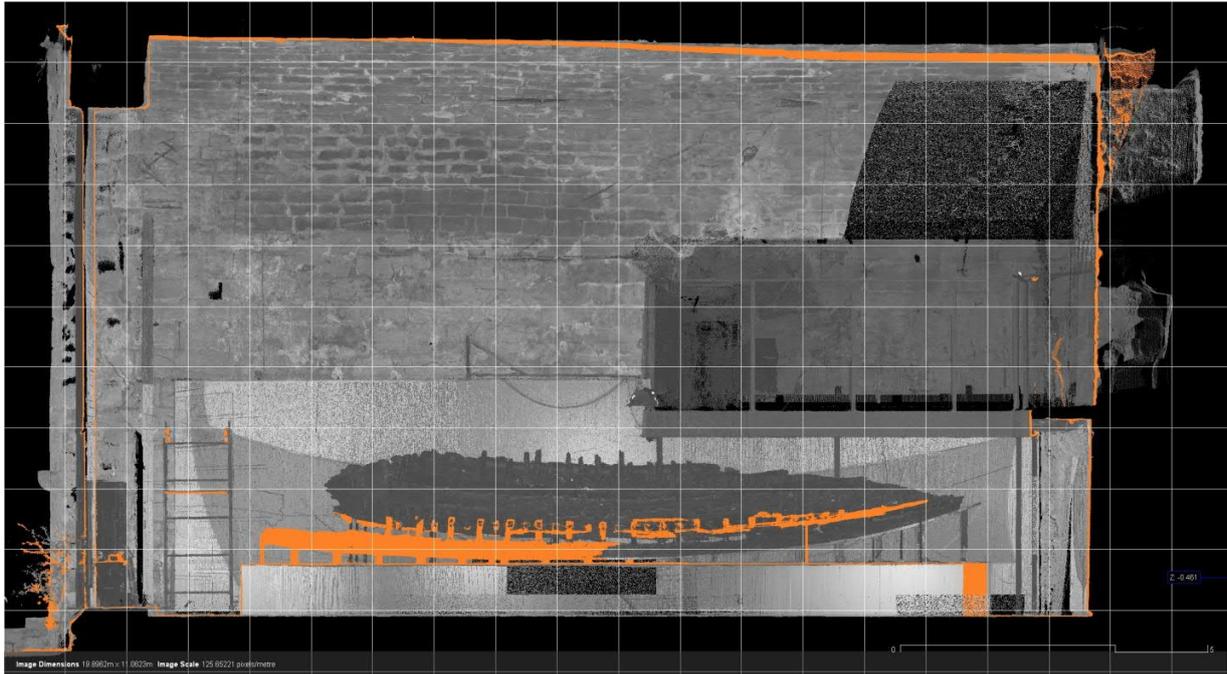


Fig. 5. Sections and plan views from the aligned point cloud

THE KYRENIA CASTLE, AN APPROACH FOR DIGITAL DOCUMENTATION IN CYPRUS ISLAND

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 in the context of the **Kyrenia Castle in Cyprus** island, a large medieval fortification organized in a square planimetry with a side of about 150 meters and walls height up to 30 metres, gathering the occasion of a specific workshop (scheduled for one week in May 2018) and producing the first partial digital model of this large building, following the protocols and best practices in digital documentation - 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 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 operators 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 and give value to how almost neglected elements, like the ancient ship graffiti. The complete workflow with samples and QR-Code links to online resources is included in this poster to make it a useful base for sharing and discussing the whole set of activities completed on this subject.

KYRENIA CASTLE WORKSHOP MAY 2018 **MASTER DEGREE THESIS 2018-2019**

YOU ARE HERE **PROCESS DEVELOPMENT**

SOCIAL NETWORK DISSEMINATION

3D LASER SCANNING <i>data gathering + treatment</i>	STRUCTURING CONCEPTS ABOUT MUSEALIZATION	DIGITAL MUSEUM	CASTLE DIGITAL SPACE
PHOTOGRAMMETRY SIM/IM <i>aerial, terrestrial, pole, macro</i>	GRAFFITI SIM/IM <i>POST-PROCESSING</i>	VIRTUAL RECONSTRUCTION <i>Phases, Hypothesis</i>	
MUSEOGRAPHY/MUSEOLOGY <i>analysis + design</i>	UAV and GROUND PHOTOGRAMMETRY <i>POST-PROCESSING</i>	3D PRINTING <i>Parts, Touchable model</i>	
DATA TREATMENT + DESIGN <i>Image treatment + CAD + 3D data</i>	CLOSE-UP ELEMENTS PHOTOGRAMMETRY <i>POST-PROCESSING</i>	FULL BIM DEVELOPMENT	
DATA GATHERING <i>Photographic, Metric, Direct, Historical</i>	PRE-BIM DATA ORGANIZATION	NEW WORKSHOP 2019	

TEACHING *on field + classes*

SCIENTIFIC DISSEMINATION

PERSONAL RESEARCH PROCESSING	SPECIALISTIC Ph.D. THESIS 2018-2019	ADVANCED RESEARCH PROCESSING
-------------------------------------	--	-------------------------------------

YOUTUBE VIDEOS FROM THE WORKSHOP

- READING AND DESIGNING THE KYRENIA CASTLE
- GRAFFITI PHOTOGRAMMETRY
- UAV PHOTOGRAMMETRY FIRST RESULTS

SURVEY TOOLS

- DJI Spark UAV unit
- Z+F IMAGER 5006 3D LS
- 3D EYE UNIT POLE + CAMERA
- NIKON D800E DIGITAL FX SLR

3D DIGITAL MODEL OF THE CASTLE

- HISTORICAL INFORMATION
- CONSTRUCTION INFORMATION
- STRUCTURAL INFORMATION
- EXHIBITION INFORMATION
- PATHOLOGIES INFORMATION
- FRUITION INFORMATION

SPECIALIZED MODELS OF THE CASTLE

MONITORING **DISSEMINATION** **MUSEUM DESIGN** **RESTORATION**

DEVELOPMENT PERSPECTIVES

CHNT 23 **VISUAL HERITAGE** **2018 EUROPEAN YEAR OF CULTURAL HERITAGE**

Giorgio VERDIANI | Stefano BERTOCCI - Dipartimento di Architettura, Firenze University, Italy
 Alessandro CAMIZ - Öğrenci Üni. İstanbul, Turkey
 Zeynep CEYLANLI - Dep. of Ar. Architecture & Environmental Design, Öğrenci Üni. İstanbul, Turkey
 Muge SEVETOGU - Cyprus International University, Center for Archaeology, Cultural Heritage and Conservation

Fig. 6. The poster (original in UNI A0 format) as presented in occasion of the Cultural Heritage and New Technology / Visual Heritage Conference, Vienna, 2018

ACKNOWLEDGEMENTS

The workshop “Reading and Designing the Kyrenia Castle” is one of the results of the ongoing scientific collaboration between Girne American University (Department of Interior Architecture) with the Department of Architecture of the University of Florence and the Department of Interior Architecture of Özyeğin University. The workshop took place between the 6th and the 13th of May 2018 at Girne American University, Cyprus Island. We would like to thank all the members of the scientific committee and in particular Giovanni Carbonara, Roberto Secchi, Kutsal Öztürk, Orhan Hacıhasanoğlu, Stefano Bertocci, Carlo Bianchini and Daniela Esposito, for the collaborative support. Within the organizing committee, a special acknowledgement must be given to Pembe Özen and to the entire Department of Antiquities and Museums for continuous participation. Within Girne American University, Faculty of Architecture, Design and Fine Arts, which made this workshop possible and supported it economically, special thanks must be given to Valentina Donà, and Carmelo Cascino.

REFERENCES

- Martina Attenni, Marika Griffo, Almira Khafizova, and Sofia Menconero. 2019. A Workflow for Fast 3D Documentation, in Proceedings of the 23rd International Conference on Cultural Heritage and New Technologies 2018. CHNT 23, 2018 (Vienna 2019).
- Ángel Benigno González Avilés (Editor). 2017. Defensive Architecture of the Mediterranean XV to XVIII centuries - Volume 6. Publicacions Universitat D'Alacant.
- Stefano Bertocci, Giorgio Verdiani, and Muge Sevketoglu. 2019. Graffiti Photogrammetry, Extracting the Signs from the Walls of the Kyrenia Castle, in Proceedings of the 23rd International Conference on Cultural Heritage and New Technologies 2018. Vienna.CHNT 23, 2018 (Vienna 2019).
- Stefano Bertocci, Sandro Parrinello, and Rebeka Vital. 2014. Masada Notebooks. Report of the research project, Iiriti editore, Italia.
- Ambrose Bierce. 1980. The Devil's Dictionary, Library of Alexandria.
- Marco Bini and Stefano Bertocci. 2012. Manuale di rilievo architettonico e urbano, CittàStudi, Torino.
- Emma Blake and A. Bernard Knapp. 2008. The Archaeology of Mediterranean Prehistory, Wiley Blackwell Studies in Global Archaeology, John Wiley & Sons.
- Stefano Brusaporci. 2015. *Handbook of research on emerging digital tools for architectural surveying, modeling, and representation*, Advances in Geospatial Technologies: IGI Global.
- Alessandro Camiz, Giorgio Verdiani, and Zeynep Ceylanli. 2018. International workshop: reading and designing the Kyrenia castle. in Sandro Bertocci. ed., *Conference Proceedings of Symposium of representation scientific area for development of multidisciplinary international programs*. Florence: DIDApres, pp. 264-298.
- Alessandro Camiz. 2018. History, techniques and restoration in the island of Cyprus. in Rosa Anna Genovese ed. *Historic Cities and Heritage as the Hubs of Social and Cultural Integration, Sustainability and Innovative Technologies*. Napoli: Giannini Editore. pp. 315-338.
- Alessandro Camiz, Marika Griffo, Seda Baydur, F.T. Fidan, and Siepan Khalil. 2017. The round corner tower of Kyrenia's city walls (1211-1232). in A.B. González Avilés, ed. *Defensive Architecture of the Mediterranean XV to XVIII centuries*, Alicante: Editorial Publicacions Universitat D'alacant. pp. 55-62.
- Alessandro Camiz, Siepan Khalil, Sara Cansu Demir, and Hassina Nafa. 2016. The Venetian defense of the Mediterranean: the Kyrenia Castle, Cyprus (1540-1544). in Giorgio Verdiani ed. *Defensive architecture of the Mediterranean. XV to XVIII Centuries*. vol. 3, Firenze: DIDApres. 371-378.
- Zeynep Ceylanlı, Pembe Özen, Ezgi Çiçek, and Pelin Arslan. 2019. Evolving from castle to virtual space: the case of Kyrenia Shipwreck Museum. in Proceedings of the 23rd International Conference on Cultural Heritage and New Technologies 2018. CHNT 23, 2018 (Vienna 2019).
- Camille Enlart. 1899. *L'art Gothique et la Renaissance en Chypre*. Paris: Ernest Leroux Éditeur.
- Leopoldo Franco. 1996. Ancient Mediterranean harbours: a heritage to preserve, in *Ocean & Coastal Management*, Volume 30, Issues 2–3, Elsevier.
- Ulrike Esther Franke. 2014. The global diffusion of unmanned aerial vehicles (UAVs), or "drones", in *Precision Strike Warfare and International Intervention Strategic, Ethico-Legal and Decisional Implications*, Mike Aaronson, Wali Aslam, Tom Dyson, Regina Rauxloh (Editors), Taylor and Francis.
- Gabriele Farre, Emilia Valletta, and Zarif Ezdeşir. 2019. Letting a Wall Tell its Story: A Low-cost Interactive Proposal for Kyrenia Castle, Cyprus, in Proceedings of the 23rd International Conference on Cultural Heritage and New Technologies 2018. CHNT 23, 2018 (Vienna 2019).
- Gabriele Guidi. 2014. Terrestrial optical active sensors – Theory & applications. In Stefano Campana & Fabio

- Remondino, eds. *3D Recording and Modelling in Archaeology and Cultural Heritage-Theory and best practices*. Oxford: Archaeopress Publishers of British Archaeological, pp. 37–60.
- Gabriele Guidi, Fabio Remondino, Michele Russo, F. Menna, A. Rizzi, and S. Ercoli. 2009. A Multi-Resolution methodology for the 3D modeling of large and complex archaeological areas, in *International Journal of Architectural Computing*, Vol. 7(1), pp. 39-55.
- Gabriele Guidi and Sara Gonizzi. 2014. Image pre-processing for optimizing automated photogrammetry performances, in *ISPRS Ann. Photogramm. Remote Sens. Spatial Inf. Sci.*, 145-152. Volume II-5.
- Marco Gaiani, Fabio Remondino, Fabrizio I. Apollonio, and Andrea Ballabeni. 2016. An Advanced Pre-Processing Pipeline to Improve Automated Photogrammetric Reconstructions of Architectural Scenes, in *Remote Sensing* 2016, 8, 178, MDPI.
- Andrea Gilli and Mauro Gilli. 2016. The diffusion of drone warfare? industrial, organizational, and infrastructural constraints, in *Security Studies* 25, no. 1, pp. 50–84.
- Víctor Echarri Iribarren (Ed). 2017. *Defensive Architecture of the Mediterranean XV to XVIII centuries - Volume 5*. Publicacions Universitat D'alacant.
- George Jeffery. 1935. *A description of the Monuments of Cyprus*. Nicosia: William James Archer.
- George Hill. 1948. *A History of Cyprus. Volume 2: The Frankish Period 1192-1432*, Cambridge University Press, Cambridge.
- Michael Katzev. 1981. The Reconstruction of the Kyrenia Ship, 1972-1975, in *National Geographic Society Research Reports*, volume 13. pp. 315-328.
- Susan Katzev. 2008. The Kyrenia Ship: Her Recent Journey, in *Near Eastern Archaeology*, Vol. 71, No. 1/2. pp. 76-81.
- Anna Marotta and Roberta Spallone (Eds). 2018. *Defensive Architecture of the Mediterranean XV to XVIII centuries*, vol. 8, Politecnico di Torino, Italy
- James Scott Petre. 2010. *Crusader castles of Cyprus: The fortifications of Cyprus under the Lusignans of 1191-1489*. PhD Thesis, Cardiff University.
- François Pomerleau, Francis Colas, and Roland Siegwart. 2015. "A Review of Point Cloud Registration Algorithms for Mobile Robotics", *Foundations and Trends® in Robotics*: Vol. 4: No. 1, pp 1-104.
- Pablo Rodriguez-Navarro (Ed). 2016. *Defensive Architecture of the Mediterranean XV to XVIII centuries*, vol. 1 Editorial Universitat Politècnica de València, Spain.
- Rolando Volzone, Dinâmia' Cet-iul, Matteo Bigongiari, and Federico Cioli. 2019. The Church of St. George in the Kyrenia Castle in the North of the Island of Cyprus, Bringing out the Shape of Architecture, in *Proceedings of the 23rd International Conference on Cultural Heritage and New Technologies 2018, Vienna 2019*.
- Cristina Sabbioni, May Cassar, Peter Brimblecombe, and Roger-Alexandre Lefevre. 2008. *Vulnerability of Cultural Heritage to Climate Change, Report*, EUR-OPA Major Hazard Agreement, Council of Europe, Strasbourg.
- Kali Tzortzi. 2017. Museum architectures for embodied experience, in *Museum Management and Curatorship*, 32:5, pp. 491-508. DOI: 10.1080/09647775.2017.1367258
- Giorgio Verdiani (Ed). 2011. *Il ritorno all'immagine, nuove procedure image based per il Cultural Heritage*. Lulu.com.
- Giorgio Verdiani (Ed). 2016. *Defensive Architecture of the Mediterranean XV to XVIII centuries*, vol. 3. Firenze: DIDA Press, Italy.
- Giorgio Verdiani. 2017. Fortifications and documentation: the case of Fortezza Vecchia in Livorno. State of the digital survey 2017, in *Defensive Architecture of the Mediterranean XV to XVIII centuries*, Alicante, Spain, Editorial Publicacions Universitat D'alacant, vol. 6, pp. 311-318.

Some videoclip about some phases of the workshop can be seen in a playlist at the following link: [International Survey and Design Seminar & Workshop: Reading and designing the Kyrenia Castle, 3D Laser Scanner, Graffiti Photogrammetry, Aerial Photogrammetry](#).

Imprint:

Proceedings of the 23rd International Conference on Cultural Heritage and New Technologies 2018. CHNT 23, 2018 (Vienna 2019). <http://www.chnt.at/proceedings-chnt-23/> ISBN 978-3-200-06576-5

Editor/Publisher: Museen der Stadt Wien – Stadtarchäologie
Editorial Team: Wolfgang Börner, Susanne Uhlirz

*The editor's office is not responsible for the linguistic correctness of the manuscripts.
Authors are responsible for the contents and copyrights of the illustrations/photographs.*