LAUNCHING CEREMONY OF JOINT LABORATORY CONSTRUCTION & OPENING CEREMONY OF CHINA-GREECE SYMPOSIUM ON CULTURAL HERITAGE CONSERVATION TECHNOLOGY

2021

CONFERENCE HANDBOOK

The Palace Museum
21–22,December,2021

中国-希腊文物保护技术联合实验室
China-Greece Joint Laboratory on Cultural Heritage Conservation Technology

中国-希腊文物保护技术联合实验室
CHINA-GREECE JOINT LABORATORY ON CULTURAL HERITAGE CONSERVATION TECHNOLOGY

Contents

Notes For Participants

1、Date

December 21, 2021 (Tuesday)

14:30–15:10：Launching ceremony of joint laboratory construction & Opening ceremony of China–Greece symposium on cultural heritage conservation technology

15:30–18:35: Academic report

December 22, 2021 (Wednesday)

15:00–18:05: Academic report

18:05–18:30: Closing ceremony of China–Greece symposium on cultural heritage conservation technology

Online meeting: Zoom software

2、Instruction

1）Participants are requested to download zoom software (mobile APP/Windows) without registration. Please click the following link to enter the software and join the Zoom conference:

https://us06web.zoom.us/j/86220579196?pwd=TktMYXY1RVlKRXQ4NWJ6WmdvdlMxdz09。

You can also join the conference by typing ID 86220579196 and password 378881.

2）There will be a test on the morning of December 17th (Friday). Please click the link between 9:00 and 10:00 to join the meeting for testing, and change the name with name and institute. If there is no problem, you can exit.Formal meeting is on the afternoon of December 21(Tuesday). Please click the above link to join the conference.

3)After join the conference, click the mute button in the lower left corner. When speaking, you can click the button again to turn off the mute function. If you want to play PPT during your speech, please click "Share screen" at the bottom of the screen. After finishing your speech, restore the mute state.

3、In case of technical problems, please contact the conference team，TEL：15210560691.

Orgnizational Structure

Organized by

The Palace Museum

Institute of Electronic Structure and Laser, Foundation for Research and Technology–Hellas

Supported by

Ministry of Culture and Tourism, P.R.C.

Ministry of Science and Technology, P.R.C.

Symposium Agenda

Time	Activity	Participants
December 21 (Jianfu Palace)		
14:30–15:10	Launching ceremony of joint laboratory construction & Opening ceremony of China–Greece Symposium on Cultural Heritage Conservation Technology	Guests from Department of International Cooperation, Ministry of Science and Technology, P.R.C.; Guests from Department of Science and Technology, Ministry of Culture and Tourism, P.R.C ; Secretary–general from General Secretariat of Research and Innovation; IESL–FORTH, Greece; Member of Chinese academic committee; Representative of Chinese co–construction unit; Representative of Greek co–construction unit; Director of the Palace Museum; Administrative staff of joint laboratory;
15:30–18:35	Symposium（session 1–2）	Participants
18:30–20:00	Dinner	
December 22（Digital lecture hall）		
15:00–18:05	Symposium（session 3–4）	Participants
18:05–18:30	Closing ceremony of China–Greece Sym–posium on Cultural Heritage Conservation Technology	Participants

Session 1(21st, Dec)Moderator: Lei Yong

Topic: Laser cleaning and laser spectrum analysis

15:30–15:55	Demetrios ANGLOS（IESL–FORTH, Greece）
Laser spectroscopy analysis in the services of Heritage Science	
15:55–16:20	Liu Xiaolong（Aerospace Information Research Institute, Chinese Academy of Sciences）
Multi–parameter picosecond laser system and its application in cleaning of cultural relics	
16:20–16:45	Paraskevi POULI（IESL–FORTH, Greece）
Laser cleaning principles and challenges	

Session 2(21st, Dec)Moderator: Qu Liang

Topic: Multidisciplinary collaborative archaeology and metal conservation

16:55–17:20	Tang Fei (Sichuan Provincial Cultural Relics and Archaeology institute）
Excavation and protection for cultural heritage of Sanxingdui sacrificial pit	
17:20–17:45	Vasilike ARGYROPOULOS （University of West Attica, Greece）
Green methods for the conservation of Cultural Heritage Metals	
17:45–18:10	Tian Jianhua (Nanjing Museum)
Statistical analysis and research on corrosion characteristics of bronze unearthed in Jiangsu	
18:10–18:35	Liu Hanwen（The Palace Museum）
Analysis of typical diseases of bronze unearthed in Sanxingdui	

Session 3(22th, Dec)Moderator: Paraskevi POULI

Topic: X-ray and spectral imaging techniques for cultural relics

15:00–15:25	Wei Cunfeng（Institute of High Energy Physics, Chinese Academic Science）
Technical development and application of special CT in cultural relics protection	
15:25–15:50	Ding Zhongmin（Shanghai Museum）
X-Ray computed tomography for cultural heritage and its digital application	
15:50–16:15	Amalia SIATOU（HE Arc CR, Switzerland and ImViA, France）
Conservation documentation of metal surfaces by employing reflectance transformation imaging (RTI)	
16:15–16:40	Li Guanghhua（The Palace Museum）
Application of spectral imaging technology in conservation and research of cultural relics	

Session 4(22th, Dec)Moderator: Su Yi

Topic: informatization and digital protection of Cultural heritage

16:50–17:15	Maria THEODORIDOU（ICS-FORTH, Greece）
Transforming data to semantic graphs using CIDOC CRM: the paradigm of big national and European projects	
17:15–17:40	Hou Chenchen（The Palace Museum）
Exploration of a new method for precision control of 3d data collection of cultural relics	
17:40–18:05	Nikos PAPADOPOULOS（IMS-FORTH, Greece）
Advances and applications of geoinformatics for cultural resources management	

Demetrios Anglos

Professor at the Department of Chemistry, University of Crete and Associated Researcher at the Photonics for Heritage Science Laboratory, IESL-FORTH

Demetrios Anglos is Professor at the Department of Chemistry, University of Crete and Associated Researcher at IESL-FORTH, where he leads the Applied Spectroscopy Laboratory (since 2001). He holds a B.Sc. in Chemistry (1986) from the University of Athens, Greece and a Ph.D. in Physical Chemistry (1994) from Cornell University, USA. The activities of his research group focus on a) the study of photophysics in molecules and novel nanomaterials with potential sensing applications, and b) the applications of laser spectroscopic techniques (LIF, LIBS, Raman spectroscopy) in the analysis of materials couple to the development of mobile, field-deployable instrumentation with diagnostic potential in heritage science. The output of his research is published in around 100 papers in peer-reviewed journals and has been presented in several talks at major international conferences. He has been involved in a number of EU and nationally-funded research projects. He has also co-ordinated a multi-site Marie-Curie Early Stage Training project and an Intra-European Post-Doctoral Fellowship Grant at IESL-FORTH. During the period 2001-2016, he served as the Technical Manager of the Ultraviolet Laser Facility operating at IESL-FORTH, which is currently a member of LASERLAB-EUROPE. Over the past few years he has concentrated his attention on European and National Initiatives which aim at developing Research Infrastructures relevant to Cultural Heritage Science, E-RIHS (European Research Infrastructures for Heritage Science) and E-RIHS.gr. Since 2012, he is a member of the Editorial Board of Heritage Science. He is teaching Physical Chemistry (Molecular

Spectroscopy) in the Chemistry department at the University of Crete, an advanced laboratory course on modern laser-based research for Chemistry majors and a graduate course on Laser Spectroscopy. He has supervised several undergraduate and graduate research thesis projects (20 diploma, 10 MSc, 4 PhD). As of fall 2012 he is a member of the Editorial Board of Heritage Science, a new open access journal published by Chemistry Central.

Laser spectrochemical analysis in Heritage Science

The study, conservation and protection of works of art and antiquities are essential for knowing, understanding and preserving our cultural heritage. But the meaningful study and successful conservation of heritage objects represent important scientific and technological challenges because of the inherently complex, multi-component nature of materials in such objects, which quite often suffer additionally from different causes of natural or anthropogenic degradation or deterioration. As a result, to identify materials on or in heritage objects and to implement optimal conservation methodologies relies on the existence of effective tools for non-invasive diagnosis and safe intervention. In this respect, analytical spectroscopies based on the use of laser sources have been proven capable of illuminating complex diagnostic problems encountered in the course of studies of heritage objects and monuments. By controlling the wavelength of irradiation and/or the photon flux it is possible to achieve different regimes of light-matter interactions and therefore to probe materials from different perspectives. Selected examples will be presented based on the use of laser-induced breakdown microscopy (LIBS) and relevant mobile instrumentation that enables measurements to be carried out on location.

Liu Xiaolong

An associate researcher at the Institute of Air and Space Information Innovation, Chinese Academy of Sciences

Xiaolong Liu, Ph.D., M.S., is an associate researcher at the Institute of Air and Space Information Innovation, Chinese Academy of Sciences, and a member of the Youth Innovation Promotion Association of Chinese Academy of Sciences. His main research interests are ultrafast laser system design and application, and he has made innovative work in the research fields of laser–matter interaction, laser processing and laser cleaning of cultural relics. He is engaged in the research and development of picosecond lasers and basic theoretical and applied fundamental research on laser–matter interaction. His research includes: research on picosecond laser technology and the development of picosecond lasers; research on the interaction mechanism of laser with materials and devices and its application in the fields of laser cleaning of cultural relics and laser remote action; research on the "filamentation" phenomenon of ultrashort laser transmission in optical media, including transmission dynamics, nonlinear phenomena and control, and research on the application of laser filamentation based on the "laser–slitter" phenomenon. Basic research on the application of laser filamentation (laser induced high voltage discharge, laser micro and nano processing, laser spectral detection, etc.). The basic theory and application of ultrashort laser processing, including spatial and temporal control of laser beam, linear and nonlinear control of laser transmission process, and the basic theory and experimental research on the interaction between ultrashort laser and materials.

Multi-parameter picosecond laser system and its application in cleaning of cultural relics

With the rapid development of laser technology, laser cleaning has been widely used in the research and practice on cleaning and restoration of cultural relics. Much efforts has been paid on key technology studies and experimental research about laser cleaning of kinds of cultural relics, such as stone, metal and paintings. It has been demonstrated that laser cleaning is an effective way on cleaning of cultural relics and laser parameters like central wavelength and pulse duration play important roles on the cleaning output. But till now, few works report systematic research about cultural relics cleaning using ultrashort laser pulses. Based on laser cold micromachining mechanism using ultrashort lasers, we present the design and development of a multi-parameter controllable picosecond laser system and the related laser cleaning platform on cultural relics in this presentation. Laser cleaning attempts on stone and bronze samples based on the above mentioned cleaning platform are also shown. The experimental results primarily verify that ultrashort laser cleaning has advantages in the cleaning of cultural relics.

Paraskevi Pouli

Principal Application Scientist at the Photonics for Heritage Science Laboratory , IESL-FORTH

Paraskevi Pouli is a Principal Application Scientist at IESL-FORTH, Photonics for Heritage Science group, in charge of developing novel laser technologies for restoration of art and antiquities. She holds a degree in Physics from Aristotle University of Thessaloniki, Greece and a Ph.D. in Physics from Loughborough University, UK. She joined IESL-FORTH on 2000 with research interests focused on the investigation of laser ablation on CH materials and the development of laser-cleaning methodologies on real cases. The understanding of laser induced discoloration and optimization and monitoring of cleaning process are her research priorities. She is involved in a number of EU and nationallyfunded research projects. Her research has been published in over 52 publications in peer reviewed journals and conference proceedings. In 2009 she joined the International scientific committee of the LACONA (Lasers in the Conservation of Artworks) Conference Series, while she has been also actively contributing in the organization of several other conferences. Over the past few years she is vigorously participating to EU and national initiatives on the development of E-RIHS (European Research Infrastructures for Heritage Science) and E-RIHS.gr Research Infrastructures focused in the field of Heritage Science. In 2001 she undertook, on behalf of IESL-FORTH, for the laser-cleaning projects on the Athens Acropolis sculptures (i.e. the Parthenon West Frieze, the ceiling of the Erechtheion Prostasis, the Caryatids at the Acropolis Museum etc.). The outcome of this collaboration is a prototype laser system and a laser cleaning methodology customarily developed in order to ensure the removal of thick pollution accumulations in a controlled and safe way for both the object and the operator. In this context the Acropolis Museum and IESL-FORTH have been awarded the 2012 Keck Award by

the International Institute for Conservation of Historic and Artistic Works (IIC) for their collaboration regarding the "laser rejuvenation of Caryatids opens to the public at the Acropolis Museum: A link between ancient and modern Greece"

Laser cleaning principles and challenges

The use of laser light to selectively remove and/or precisely reduce encrustations and unwanted/altered layers from the surface of cultural heritage (CH) objects and monuments was systematically investigated during the past thirty years bringing a significant breakthrough in the field. In this presentation a number of successful laser cleaning projects will be presented with emphasis on the critical and decisive parameters that were taken into account for the development of the cleaning methodology. In parallel, issues related to careful assessment of the treated surfaces and reliable monitoring of the process are also discussed. As a final point the laser cleaning interventions on the Athenian Acropolis Sculptures will be discussed highlighting the experience gained from setting a laser laboratory in situ at the archaeological site and the Museum and its evolution to a laboratory open to the public.

Tang Fei

President of Sichuan Provincial Cultural Relics and Archaeology institute, and a research fellow

Tang Fei is the president of Sichuan Provincial Cultural Relics and Archaeology institute, and executive deputy director of Cultural Route Protection Research Committee of ICOMOS CHINA. He is the leader in the field of cultural heritage protection in southwestern China. He enjoys special government allowances of the State Council. He is the experts of cultural heritage planning and protection, members of the historical and cultural city town village protection committee, Sichuan provincial committee member of world heritage, He is a teacher of Sichuan university and Southwest University of Science and Technology. He presided over the major project of "Archaeological China" "Research on the Bashu Civilization In Sichuan and Chongqing Region", he also presided over the compilation of "Sichuan and Chongqing Grottoes Protection and Utilization Project" into the 13th Five-year Plan of The State. He organized Sanxingdui archaeological excavation, cultural relics protection, exhibition and utilization, and developed an internationally leading integrated archaeological platform of excavation and protection. The "Sanxingdui" mode of excavation and protection has been formed with a style of "subject presetting, synchronous protection, multi-disciplinary integration and multi-team cooperation", and it has made great efforts to practice the principle of "Archaeology with Chinese characteristics, Chinese style and Chinese style".

Excavation and protection for cultural heritage of Sanxingdui Sacrificial Pit

"Sleep for three thousand years, a wake up to the world". Located in northwestern Sichuan Guanghan Sanxingdui ruins, known as "one of the most important archaeological discovery" of the 20th century, the discovery of Sanxingdui ruins and the Sanxingdui relics unearthed, especially bronze ware, jade, gold, ivory and other cultural relics were excavated in the sacrificial pit, toppled the understanding of the ancient Shu civilization. It proves that the origin of Chinese civilization is diversified and integrated. This report focuses on the problems existing in previous excavations at Sanxingdui Site, including environmental detection and control of unearthed cultural relics, micro extract and emergency protection of unearthed cultural relics, tracking and detecting the preservation status of unearthed cultural relics, research on the protection of unearthed ivory and decayed bronze relics. The important role of multidisciplinary collaboration in excavation and protection of Sanxingdui sacrificial pit was highlighted and the future archaeological excavations are also prospected in this report.

Vasilike Argyropoulos

Professor in Conservation of Metals at the Department. of Conservation of Antiquities & Works of Art, University of West Attica

Vasilike Argyropoulos is a Professor in Conservation of Metals at the Dept. of Conservation of Antiquities & Works of Art, University of West Attica, Athens, Greece since 1998. Recently, she was a Visiting Professor at the University of Toronto, Museum Studies Program (March–September 2020). Since 1990, she has been involved in conservation of Cultural Heritage, which began with an international project with the University of Toronto to set-up a conservation laboratory at the Museum of Carthage in Tunisia. After her PhD, she was awarded a grant at the Historic Research Conservation Branch at Parks Canada, and carried out research on historical shipwrecks found underwater in the Marine Park of Fathom Five National Park. For the past 23 years, she has held an academic position at the University, and was successful in achieving full professorship in Metals Conservation. She has been responsible for teaching and creating a laboratory in her field where through various grants, she was able to equip her Lab with state-of-the-art equipment for diagnostic analysis and testing of metals. Her main project was PROMET, EC 6th FP project No. 509126, Developing new analytical techniques and materials for monitoring and protecting metal artefacts from the Mediterranean region with 21 partners (2004–2008), and the EC Culture Programme No. 160674-CU-1-2009, Witness the past: educational programs for the public and CH professionals on illicit trafficking of antiquities (2010–2012). Her most recent national funded research project dealt with research on the corrosion and in-situ monitoring of iron shipwrecks in the Aegean Sea (2013–2015). As the Convenor of European standards' technical committee for the conservation of cultural property, CEN/TC 346 WG2, Materials constituting cultural property (2012–2016), as well as a board member for ENCoRE (European Network for Conservation-

Restoration Education). She has supervised many Ph.D. and Masters Students, and undergraduate dissertations involving research in conservation of cultural heritage, as well as has organized many international workshops, conferences, and diploma courses for conservation and conservation science. Finally, she has over 70 peer reviewed publications, as well as edited books and journals related to conservation of cultural heritage.

Green methods for the conservation of Cultural Heritage Metals

In last decade, there has been an increase in research related to green methods or materials for conservation of metals cultural heritage to help promote sustainable practices in the field that are safe, environmentally friendly, and ecologically acceptable. The presentation will discuss a collaborative project established over 10 years ago under the acronym PROMET entitled: "Innovative conservation approaches for monitoring and protecting ancient and historic metals collections from the Mediterranean region", financially supported by European FP6–INCO (2004–2008) that studied green corrosion inhibitors and coatings for the protection of metals in museum collections. The project also established a protocol for the testing of coatings and corrosion inhibitors on material culture made of metals involving a common methodology. Since the project, there has been many research studies into the use of green corrosion inhibitors and coatings for metals cultural heritage (Argyropoulos et al. 2021). For conservation purposes, the most studied green corrosion inhibitor has been the amino acid type known as cysteine for copper alloy artefacts. The presentation will describe the research carried out by our Laboratory on this type of corrosion inhibitor deemed to be a replacement to the commonly used and toxic corrosion inhibitor, benzotriazole for copper alloy artefacts. The presentation will describe some of the problems associated with research into green corrosion inhibitors for metals and the way forward in addressing the need.

Tian Jianhua

Professor of Nanjing Museum

Tian Jianhua, born in 1980, is a professor of Nanjing Museum. She majored in Heritage Conservation Technology, Northwestern University and Archaeometry, University of Science and Technology of China, where she got her doctor's degree. She is mainly engaged in metallurgical archaeology and metal relics conservation. Resent years, she has been responsible for several research projects in the field of cultural relic conservation and Archaeometry, and has restored many important relics such as glass chimes and silver horse ornaments from King's Mausoleum in Dayun Mountain in Xuyi. She has also published more than 20 articles.

Statistical analysis and research on corrosion characteristics of bronze unearthed in Jiangsu

In order to investigate the corrosion characteristics of bronze unearthed in Jiangsu and its relationship with the buried environment. XRF, Raman, metallographic analysis, ultra-depth-of-field microscopy and other methods were used to examine more than 10 typical bronze groups from the Western Zhou Dynasty to Tang Dynasty in Jiangsu. The results show that the bronzes of the northern Jiangsu sites such as the Gaozhuang Tomb of the Warring States Period in Huaiyin and the King's Mausoleum in Dayun Mountain in Xuyi are generally well preserved, and the rust is mainly composed of dense cuprite and malachite. The bronzes in the coastal areas such as Yinwan Tomb of Han Dynasty in Lianyungang are severely mineralized, and the corrosion is generally chlorine-containing and mostly powdery. The corrosion status of the bronzes in the southern Jiangsu sites and Yangzhou relics such as the Huqiu Road Brick Chamber Tomb in Suzhou and the Tomb of Sui Yang Emperor in Yangzhou is more complicated, contains both Chlorine-free powder rust and chlorine-rich corrosion products. Generally, it is causally consistent with the buried environment that the soil in northern Jiangsu is mainly alkaline, the soil in the coastal plain is rich in chlorine, and the soil in southern Jiangsu is severely acidified.

Liu Hanwen

The Palace Museum

Liu Hanwen, works in the Department of Cultural Heritage Conservation Standardization in the Palace Museum. Liu Hanwen graduated from the school of materials science and engineering, Tsinghua University, and entered the Palace Museum in 2016 to engage in cultural Heritage conservation. The main research direction is non–invasive analysis and detection and scientific conservation technology of cultural heritage. In recent years, Liu Hanwen has mainly focused on the analysis of rust products of bronze cultural relics and the study of disease mechanisms.

Analysis of Typical Diseases of Bronze Unearthed in Sanxingdui

The Sanxingdui site is an important representative of the world's bronze civilization from the 16th century BC to the 14th century BC. It occupies an important position in the development history of human civilization. It is the largest capital site with a regional center in Southwest China, and more than a thousand pieces of gold have been unearthed, including bronze, jade, stone, pottery, shells, bones and other precious artefacts. Among them, a large number of bronze artifacts provide rich and informative materials for the study of ancient history.of southwest China. These Bronze artefacts are majestic and unique in shape and urgently need to be protected. Therefore, it is necessary to perform scientific analysis of the diseases of these bronze artefacts. Due to the special burying environment in Sanxingdui area, the rust products in the unearthed bronzes are very special. They look blue–white in appearance, which resembles the powdery harmful rust we usually call, and there is often a shell on the surface. From the excavation to the present, this blue–white rust has hardly any obvious color fading, and it does not spread due to the unfavorable preservation environment in Sichuan,, but it has become loose and powdery, and even falls on the touch. In this study, through the scientific analysis and testing of the bronzes unearthed in Sanxingdui, the cognition of the typical diseases of the bronzes in Sanxingdui area was established, laying a good foundation for further protection.

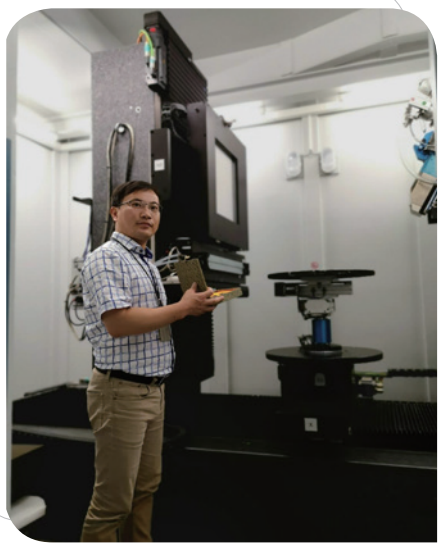
Wei Cunfeng

A researcher at the Institute of High Energy Physics, Chinese Academy of Sciences

He is a researcher at the Institute of High Energy Physics, Chinese Academy of Sciences, where he is the director of the Nuclear Technology Application Research Center and a doctoral supervisor. Recent years' research focus: 1. X-ray energy spectrum CT imaging technology study 2. Small animal live/breast CT imaging technology study 3. Microscopic CL technology and its application in chip packaging inspection 4. Room temperature semiconductor X-ray detector system development. Major projects in progress: 1.X-ray 3D layered imager, National Key Research and Development Program, project leader. 2.One research equipment development project of Chinese Academy of Sciences.

Technical development and application of special CT in cultural relics protection

X-ray CT technology can nondestructively provide the internal structure information of objects, which is of great significance to the study of the cultural relics. It is playing an increasingly important role in the field of cultural relics protection. However, most of the current CT scanners used for cultural relics are general industrial CT scanners, not specifically developed for the application of cultural relics. In the process of CT scanning, cultural relics need to be rotated and the positions of X-ray source and detector need to be adjusted, which cause great security risks to cultural relics. In addition, special cultural relics such as long-axis cultural relics and damaged cultural relics cannot be scanned. For solving these problems, the Institute of High Energy Physics (IHEP), Chinese Academy of Sciences, and the Palace Museum plan to develop a kind of dedicated CT for cultural relics protection. This CT scanner adopts a rotating gantry with fixed X-ray source and detectors. During the scanning process, cultural relics only need to be placed on the sample table without rotation, to ensure the safety of cultural relics to the greatest extent, and consider the scanning needs of long-axis cultural relics, damaged cultural relics and other special cultural relics. And this CT scanner is equipped with a 450kV high-energy X-ray source for strong penetration, so it is suitable for large-size cultural relics and metal cultural relics scanning. At the same time, the multi-row linear detector independently developed by IHEP can greatly improve the imaging quality, and the scanning speed is 8-16 times higher than that of the ordinary linear array industrial CT. The whole system has a compact structure and is easy to be placed in a mobile shelter with special shielding design, thus eliminating the risk of cultural relics transportation and realizing CT detection of cultural relics at the site of cultural relics and archaeological sites. The development of this equipment will greatly promote the application of CT imaging technology in the field of cultural preservation and promote the standardization of CT scanning of cultural relics.



Ding Zhongming

Associate Research Fellow of Cultural Conservation Center of Shanghai Museum

Ding Zhongming, Associate Research Fellow of Cultural Conservation Center of Shanghai Museum. Main research interests include : manufacture technologies of ancient Chinese bronze wares, lacquerwares and artifacts of other materials. He has been committed to the application of X-ray inspection technology and other modern analytical techniques, and has carried out in-depth research on the manufacture technologies of Shang and Zhou bronzes. His current research concentrates on the investigation and authentication of bronze wares, lacquerwares, Buddhist statues, ceramics and porcelains, on which he has published numerous papers. He also studies the display and valorization of the academic products with the aim of enhancing the public awareness of Chinese traditional culture. The X-CT data and images of his studies have been included in the catalogues of various exhibitions on cultural heritage. The images and videos of X-CT analysis on lacquerwares were important part of the exhibition "In A Myriad of Forms: The Ancient Chinese Lacquers"（Shanghai Museum，2018）.

X-Ray Computed Tomography for Cultural Heritage and Its Digital Application

The X-ray computed tomography (X-CT) technology is increasing valued in cultural heritage field for being non-destructive, intuitive, and of high precision. It has been widely applied to cultural relics of various materials, and plays an active role in the researches on manufacture technology, conservation and restoration, internal defects detection and authentication.Short videos made from the X-CT data of internal structures of bronze and lacquer ware comprehensively and intuitively reveal the ancient craftsman's spirit, as well as the manufacture techniques and scientific values of the artifacts, thus illustrating the splendid traditional culture to a broad audience in a simple way. The internal condition of a porcelain restored in mimetic mode was reconstructed with 3D printing based on the X-CT analysis. This kind of application facilitates the recognition of the historical restoration and the positioning of the fragments in future intervention.A number of application cases show that the X-CT technology has a promising future of digital applications. In combination with the other emerging technologies, such application will be more extensive and in-depth.

Amalia Siatou

Research Assistant at Haute Ecole Arc,
Neuchatel, Switzerland, and
PhD Candidate ImViA, UBFC, France

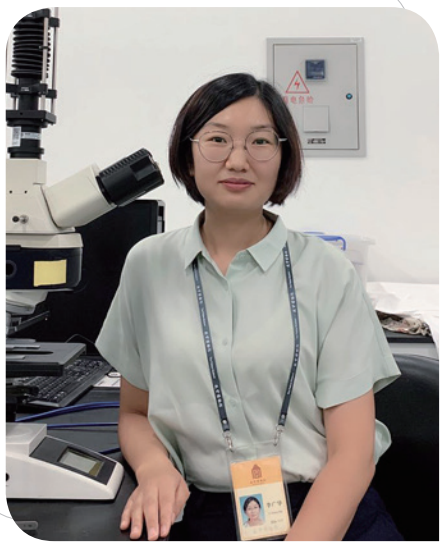
Amalia Siatou a professional Conservator-Restorer holding a bachelor in Conservation-Restoration of Antiquities and Works of Art, from the Technological Educational Institute of Athens-Greece (2004) and a Master in Chemistry and Material Science from the University of Ioannina-Greece (2013). Both her BA and MSc, as well as her professional career, correlated metals conservation with their scientific analyses and evaluation. Her BA thesis was on the desalination of historic aluminum alloys, using chemical and electrochemical treatments. Between 2005 and 2007, she has worked at the metal's conservation laboratory at the TEI of Athens on the EU project "PROMET", on the accelerated aging and evaluation of metals' protection by coatings. Since 2019, Amalia is a Marie Skłodowksa-Curie doctoral fellow collaborating with the Haute-Ecole Arc Conservation Restauration, in Neuchâtel, Switzerland and the Laboratory of Imaging & Artificial Vision of the University of Burgundy, in Dijon, France, as part of the «CHANGE-ITN» (Cultural Heritage Analysis for New Generations – Innovative Training Network) project. Her PhD research involves the characterization of historical metals by employing imaging and computer vision. Finally, Amalia is being involved in the safeguarding of the C-R profession in national and European level. She has been the vice-president of ACAWA-Gr (Association of Conservators Antiquities and Works of Art of Higher Education) for 8 years and, since 2016, is representing Greece and ACAWA-Gr in E.C.C.O. (European Confederation of Conservation-Restoration Organizations) where she is also a committee member.

Conservation documentation of metal surfaces by employing Reflectance Transformation Imaging

Visual documentation plays a key role in cultural heritage preservation, especially in condition assessment and monitoring of objects. Continuous advances in imaging and artificial vision are being embedded in the field of cultural heritage, leading to new technologies for accurate visual representation and automated tracking of alterations on objects. As part of a research, that aims to detect, characterize and monitor changes on historical metal, the application of Reflectance Transformation Imaging (RTI) is being examined for the condition assessment of metal object. The objective of this research is the implementation of technological advancements in the application of RTI that aims at exploiting information related to appearance attributes, and to physical properties based on the pixel–wise angular reflectance of a surface.

RTI has found ground in cultural heritage documentation by revealing the topography of surfaces. In parallel, new algorithms and methodologies developed for processing RTI data, with application mainly in quality control of industrial surfaces, have been able to extract geometrical and statistical information for surfaces presenting high specularity, like metals. This work examines the application of these developments on historical metal objects for documenting the appearance attributes and isolating information of interest. The methodology is based on surface visualization of geometrical or statistical calculations of the surface parameters.

These maps can reveal information that help in characterizing technological features and corrosion phenomena that provoke topographic alteration. The combination of the extracted information enhances the visualization of the object’s condition, and can create an accurate cartography of the examined surfaces. This research has received funding from the European Union’s Horizon 2020 research and innovation program under the Marie Skłodowska–Curie grant agreement No. 813789.



Li Guanghua

The Palace Museum

Li Guanghua, conservator of the Palace Museum, graduated from the School of Archaeology and Museology of Peking University in 2014, and joined the Palace Museum in the same year. She is mainly engaged in application of nondestructive technologies such as spectral imaging, FORS and so on. She is also a Conservation Scientist with specialization in the identification, technical study and conservation of polychrome objects, especially Chinese scroll paintings and architectural paintings. She has presided over a project of the Palace Museum "Research on the Application of multi/hyperspectral Imaging Technology in the Conservation of Painting and Calligraphy relics in the Palace Museum", and participated in two projects of National Key R&D Program of China. She published relevant research results in Microchemical Journal and Sciences of Conservation and Archaeology.

Application of Spectral Imaging technology in Conservation and Research of Cultural Relics

As a non-invasion and fast image analysis method, spectral imaging technology is especially suitable for the conservation and research of precious and exquisite cultural relics. Hyperspectral imaging technology can provide images and spectra at the same time, so it can not only extract hidden information such as deterioration and restoration traces of objects, but also identify the material components, which plays an important role in the research and conservation of paintings. The Palace Museum, in collaboration with Aerospace Information Research Institute, Chinese Academy of Sciences, has built a series of hyperspectral imaging equipment, which has formed a set of methods suitable for research on the painting techniques of plane polychrome objects. It can provide detailed reference for the research and conservation of such objects. At present, the Palace Museum is conducting research on the application of hyperspectral imaging technology on three-dimensional cultural relics to identify the corrosion products of metal objects. The distribution of different corrosion products can be obtained, which may provide suggestions and basis for their conservation and restoration.

Maria Theodoridou

Research & Development Engineer at the Information Systems Laboratory and the Centre for Cultural Informatics , ICS-FORTH

Maria Theodoridou is Research & Development Engineer at the Foundation for Research and Technology – Hellas, Institute of Computer Science (FORTH-ICS), Information Systems Laboratory and the Centre for Cultural Informatics (CCI). She holds a Master of Applied Science from the University of Toronto, Canada (1985) and a Diploma of Electrical Engineering from Aristotle University of Thessaloniki, Greece (1983). Maria has been actively involved in more than 20 national and international cultural information systems' projects. Her research interests include semantic web technologies, mapping technologies, conceptual modeling, cultural information systems and semantic interoperability. Currently, she coordinates the mapping technology activities of CCI that include the X3ML Toolkit a set of small, open source, microservices that assist the data provisioning and aggregation process for information integration, extensively used for mapping and transforming data from cultural heritage institutions, such as archives, libraries, and museums, but equally for research institutes of descriptive sciences such as earth sciences, biodiversity, clinical studies and e-Health. Maria was the technical/scientific coordinator of FORTH-ICS in several recent EU projects (ARIADNE, PARTHENOS, VRE4EIC, E-RIHS PP). She is currently the scientific coordinator of FORTH-ICS for the EU HORIZON 2020 Projects ARIADNEplus and 4CH.

Transforming data to semantic graphs using CIDOC CRM: the paradigm of big National and European Projects

Managing heterogeneous cultural heritage data is a complex challenge. Cultural institutions like galleries, libraries, archives and museums curate different types of collections that, even between similar types of institutions, are documented in different ways using different languages; influenced by different disciplines, objectives and geography, and are encoded using different metadata schemas. The exponential growth of the Web and the extended use of database management systems has brought to the fore the need for the seamless semantic interconnection and interoperability of these large numbers of diverse information sources. Handling these metadata as a unified whole is vital for progressing new fields of humanities research and discovery, providing more knowledgeable information retrieval and (meta) data exchange, and advancing the field of digital humanities in its various aspects. Data aggregation and integration provides a uniform source and has the potential to create rich resources useful for a range of different purposes, from research and data modeling to education and engagement. It is being accomplished by incorporating several tools for modelling, cleaning, normalizing and transforming data while preserving or even enhancing the semantics of the data. Semantic integration is achieved with the use of CIDOC CRM. The CIDOC Conceptual Reference Model (CIDOC CRM), is a semantically rich reference ontology designed to enable information interchange and integration in the field of cultural heritage and is used as a common language for domain experts and implementers providing the "semantic glue" needed to mediate between different sources of cultural heritage information, such as that published by museums, libraries and archives. The core ontology supports the whole cultural heritage community including museums, libraries and archives. There is also a growing set of compatible extensions that address specialized information such as bibliographic, excavation, scientific observation, provenance, ancient texts, archaeological buildings, argumentation and spatiotemporal information. The whole data aggregation and integration process follows the Synergy Reference Model. Synergy is a model for a better practice of data provisioning and aggregation process The model aims at identifying, supporting or managing the process when a provider and an aggregator agree to transfer data from the provider to the aggregator; to transform their format to the homogeneous format of the aggregator; to curate the semantic consistency of source and target data; and to maintain the transferred data up–to–date with respect to changes on both sides

Hou Chenchen

An engineer in the Department of IT, Imaging, and Digital Media in the Palace Museum

Hou Chenchen has been working in the Palace Museum as an engineer in the Department of IT, Imaging, and Digital Media since 2015. She primarily focuses on application, exhibition and research of the cultural heritage 3D digitization. Her study includes documenting and processing 3D data of collections and architectures, developing digital projects with 3D and VR technologies, etc. She has participated in several protective projects by digital recording the original state of architectures such as Ningshougong、Yangxindian, etc. These projects timely recorded the 3D information before the restoration of architectures. She also managed the "Virtual Forbidden City" project, flexibly apply the 3D data to display collections and architectures online for internet audience.

Exploration of a new method for accuracy control in 3D data acquisition of collections

The Palace Museum has large scale of historical architectural heritage and artifacts in collection and attracts countless tourists and cultural researchers; at the same time, there are also contradictions between preservation and public access, digital technology can alleviate some of these contradictions to a certain extent. Since 1998, we have been engaged in the application of digital technology for more than two decades. The Digital Palace Museum has formed a development model including network construction and equipment operation & maintenance, information system development and operation & maintenance, cultural heritage data acquisition and processing, and digital display and public services, research on the application of digital technologies. The model lays a solid foundation for Digital Palace Museum.This presentation will first briefly introduce the general situation of the Digital Palace Museum, and then discuss a new precision control method of three-dimensional data acquisition for movable collections.

Nikos Papadopoulos

Principal Researcher at the Laboratory of Geophysical–Remote Sensing & Archaeo–environment, IMS–FORTH

Nikos Papadopoulos holds BSc in Geology (2001) and PhD (2007) in Applied Geophysics from the University of Thessaloniki (Greece). He was a post–doctoral researcher in the Korea Institute of Geoscience and Mineral Resources, KIGAM (2008) and Visiting Fellow Researcher in University of Arkansas, USA (2013). He joined the Foundation for Research and Technology, Hellas (FORTH) in 2009 where he is currently Associate Researcher of Applied Geophysics in Cultural Heritage and head ofthe Laboratory of Geophysical–Satellite Remote Sensing & Archaeoenvironment (GeoSat ReSeArch Lab). His research interests include the numerical modeling and inversion of resistivity tomographic data, the implementation of diverse geophysical methods for near surface archaeological, environmental, urban, shallow marine applications and the employment of geoinformation technologies in cultural and natural resources management. He has participated and/or organized in more than 130 geophysical projects in Greece, Cyprus, Hungary, Egypt, USA, Australia and S. Korea and has been the coordinator/ main researcher in 36 National and EU funded large scale projects. He is Associate Editor of Journal of Archaeological Prospection and Near Surface Geophysics and Topic/Guest Editor in Remote Sensing.

Advances and applications of geoinformatics for cultural resources management

Geoinformatics have given a new dimension and perspective in the domain of archaeological research over the last years. The high resolution geophysical mapping using standard and motorized instrumentation, the innovative satellite recording systems of high spectral and spatial resolution, the use of Geographical Positioning Systems and the improved processing systems of digital images and data processing provide great possibilities in extracting spatial and temporal attributes from the archaeological sites. The use of three dimensional (3-D) modeling and virtual reality methods aim in the monument representation and the reconstruction of the surrounding environment of the archaeological sites. The combination of the above information within Geographic Information System platforms with other data bases coming from archaeological investigations, environmental information and social-economic models provide valuable results regarding the land use during the ancient times. Integrated applications from different terrestrial and submerged archaeological sites in eastern Mediterranean show the capabilities of geoinformatics and 3-D modeling in cultural resources management.