

# Digital & Documentation V5. From Virtual space to information database Programme

Ass. Prof. Francesca Picchio, Event Coordinator of D&D 2022 Pavia Prof. Axel Berkofsky, Delegate for Internationalisation Prof. Alessandro Reali, Department of Civil Engineering and Architecture Prof. Francesca Fatta, President of UID - Unione Italiana Disegno Prof, Sandro Parrinello, Scientific Responsible of Pavia DigiWeek 2022

### **SESSION 1**

Chair: Prof. Sandro Parrinello, University of Pavia Prof. Massimiliano Lo Turco, Polythecnic of Turin

Prof. Jacek Lebiedź, Gdansk University of Technology Virtual reality as a tool for development and simulation. Research projects and experience of the University of Gdansk.

#### Ass. Prof. Davide Benvenuti, Nanyang Technological University

From drawing to animation. The creation of virtual places and the development of storytelling for the construction of narrative paths through drawing.

Flavia Camagni, La Sapienza University of Rome Exploration of illusory spaces: use of AR and VR for the analysis of Architectural Perspectives.

#### Francesca Galasso, University of Pavia

Revealing the invisible: digital simulacra and virtual use of lost archaeological heritage.

#### Andrea Lumini, Federico Cioli, University of Florence

Project AURA: Acoustic simulation of theatre halls - from digital survey to virtual reconstruction.

#### Marianna Calia. Margherita Tricarico. University of Basilicata

From survey to simulation of a virtual space: UNESCO World Heritage sites in South East China and Archaeological Heritage in Basilicata.

#### Sofia Menconero, Roma Tre University

Simulation of space in the Piranesi Prisons between architecture, perspective and perception.

#### Elisabetta Caterina Giovannini, Polythecnic of Turin

Digital ecosystems for the virtual analysis of Porta Aurea in Ravenna.

Pavia, Chiesa Santi Giacomo e Filippo 19-09-22

### 1430 SESSI

Information Databases and Information Systems for Architecture

Chair: Prof. Cettina Santagati, University of Catania Ass. Prof. Francesca Picchio University of Pavia

#### Keynote Speakers

**Prof. Marco Morandotti**, *University of Pavia* Cultural Heritage digital asset management: a forthcoming revolution.

**Prof. Boguslaw Szmygin, Brtosz Szostak**, *Lublin University of Technology* Heritage BIM - tool and methodology.

#### 530 Panel Presenta

Fabiana Raco, University of Ferrara Digital documentation for the enhancement of Brazilian Cultural Heritage; Museo Do Ipiranga, Parque da Independência and Monumento à Independência.

Fausta Fiorillo, Polytechnic of Milan Data management, efficient use and engaging fruition of reality-based models via web platforms.

#### Raffaele Catuogno, University of Naples Federico II

Digitalization for Heritage: a cognitive platform for smart communication.

#### Pamela Maiezza, University of L'Aquila

3D Models for Architectural Heritage Documentation: Transparency and Reliability Issues.

#### Elisabetta Doria, University of Pavia

Databases and drawings to support the development of the documentation project. The case study of 'Le Torricelle' wall in Verona.

#### Andrea di Filippo, University of Salerno

Traceability of geometric attributes in Bim models for the heritage documentation.

#### Proceedings Presentatio

Prof. Graziano Mario Valenti, La Sapienza University of Rome Presentation Proceedings of D&D 2020 Rome

Prof. Laura Inzerillo, University of Palermo Presentation Proceedings of D&D 2021 Palermo

#### 18:30 D&D 2022 Closing Event - Round Table

Chair: Prof. Alessandro Luigini, Free University of Bozen-Bolzano Prof. Cecilia Maria Bolognesi Polytechnic of Milan

## Session 1 Perception: Virtual spaces, simulations and interactions

# keynote speaker



## JACEK LEBIEDŹ

Gdańsk University of Technology (POLITO) – Department of Architecture and Design (DAD) – Torino.

M.Sc. Eng. in Computer Science from the Faculty of Electronics at the Gdańsk University of Technology, M.Sc. in Mathematics from the Faculty of Mathematics, Physics and Chemistry at the University of Gdańsk, and Ph.D. in Computer Science from the Faculty of Electronics, Telecommunications and Informatics at the Gdańsk University of Technology, where he is now a deputy head of the Department of Intelligent Interactive Systems.

He was a co-initiator and co-designer of the Immersive 3D Visualization Lab, which he is currently a head of. His current research focus has been computer graphics and virtual reality.

VIRTUAL REALITY AS A TOOL FOR DEVELOPMENT AND SIMULATION. RESEARCH PROJECTS AND EXPERIENCE OF THE GDAŃSK UNIVERSITY OF TECHNOLOGY

The lecture will concern the potential of the Immersive 3D Visualization Lab, at the Faculty of Electronics, Telecommunications and Informatics, Gdańsk University of Technology, Poland, and its applications developed in collaboration with various institutions and research centers. The basic installation of the lab is a virtual reality cubic CAVE with six screen-walls, where a user can navigate through virtual space using more or less specialized controllers. The most unconventional controller is a freely revolving transparent sphere, supported on rollers (something like an omnidirectional hamster wheel capable of accommodation a human user) enriched with a motion tracking system. A user's gait causes the sphere to rotate and triggers changes in the computer rendered 3D images generating an impression of motion in virtual space.



# keynote speaker



## DAVIDE BENVENUTI

Nanyang Tecnological University (NTU) – School of Art Design and Media (ADM) – Singapore.

Assistant Professor of digital animation at NTU ADM School of Art Design and Media Singapore since January 2013. Graduated with a master's degree in architecture at Florence University he has been engaged by Disney, DreamWorks, and Ubisoft. Among his credit list:

"Assassin Creed Black Flag", "Assassin Creed III"," Assassin Creed Revelation"; "Assassin Creed II" (Ubisoft Singapore); "Sinbad Legend of the seven seas"; "Sprit stallion of the Cimarron" (DreamWorks) Senior Animator at Disney animation Australia from 1995 till 2006 he worked on many direct to DVD titles and feature film including "The jungle Book II"," Peter Pan Retour to Nederland", and "Bambi and the great Prince of the forest". Winner of The Gold Award for Digicon6 2018 in Singapore with his 3D animated film "Apple of my eye" he is currently working on his second short film "Summer tale"; part of his ongoing research on tool development for 2D animation. http://www.imdb.com/name/nm0073045/.

FROM DRAWING TO ANIMATION. THE CREATION OF VIRTUAL PLACES AND THE DEVELOPMENT OF STORYTELLING FOR THE CONSTRUCTION OF NARRATIVE PATHS THROUGH DRAWING

Animation, like painting, illustration, and cinema, is constantly inspired by reality. The graphic research combined this with the necessity to involve the viewer often starts from recognizable places.

Animation allows us to overcome the limits of photography; the "real" frequently becomes a simple starting point modified and conceptualized with alterations dictated by the stylistic needs of the story.

It is precisely these alterations that make this subject an exciting field of study.

From photo-realistic to fantastic or strongly abstract architectures, the architectural element helps define the reference scale, period, and location, often inserting an element of familiarity that will help draw in the intended audience in.



Stylistic considerations often mediate the need to be truthful to reality. Animation, since its inception, has explored new stylistic languages and techniques: artists like Tyrus Wong, Mary Blair, Eyvind Earle, Gerald Scarfe, Ronald Searle, Ken Anderson, Morice Noble, Hayao Miyazaki, Lorenzo Mattotti, and even Salvador Dali have contributed with unique and different styles to create memorable images.

This research presentation will address the relation between animation and the location study. I will illustrate that understanding architecture and exploiting illustrative style can be combined to develop storytelling through appropriate design methodologies. I will focus on graphic research for a specific project within this framework.



## FLAVIA CAMAGNI

La Sapienza University of Rome (UNIROMA) – Department of History, Design and Restoration of Architecture – Roma

Architect, Phd awarded in 2021 at the Department of History, Design and Restoration of Architecture at Sapienza University of Rome. During this training she has developed studies involving representation and in particular perspective, both in its historical and current aspects with particular attention to architectural perspectives and perspective wooden inlays. These studies are often conducted with the help of digital three-dimensional models based on the study of drawings, perspective restitution and survey data and aimed at the enhancement of the studied assets through the use of new technologies in the field of representation.

# > EXPLORATION OF ILLUSORY SPACE: USE OF AR AND VR FOR ANALYSISM OF ARCHITECTURAL PRESPECTIVES

The research presented aims to investigate the use of new technologies such as Augmented Reality (AR) and Virtual Reality (VR) as a tool for the analysis of Architectural Perspectives.

These technologies allow, through the use of three-dimensional models, to simulate scenarios and interactions with strong communicative power that introduce themes such as the perception of illusory spaces, thanks to their fundamental characteristics such as immersiveness and interaction, through which the user comes into contact with virtual scenarios.

The viewer who comes face to face with large perspective frescoes, or more modestly sized wooden marquetry, is strongly influenced by what their eye perceives as a dilated space, i.e., a virtual space; this occurs in other ways in



VR and AR applications as well. This research aims to highlight the link between perspective and immersive systems. In particular, it aims to bring to light the different types of interactions that the user can get from the use in new technologies if they are applied to the chosen theme. And again, understand how, through perceptual experience, illusory space can best be represented with the selected digital tools.

The use of these instruments for the study of Architectural Perspectives is intended to represent the innovative contribution that this study proposes, relating to the suggestive aspect that quadrature could arouse in the viewer of the past, deceiving the eye and dilating the space, and the interest that new technologies stimulate in the contemporary viewer, capable of astonishing and showing new realities.



## FRANCESCA GALASSO

University of Pavia (UNIPV) – Department of Civil Engineering and Architecture (DICAr) – Pavia.

PhD Candidate in Design, Modeling and Simulation in Engineering (cycle XXXV) at the University of Pavia. She graduated in Building Engineering and Architecture in September 2018 at the same university. Currently, she actively collaborates within the research laboratory DAda Lab dealing with research projects on three-dimensional geometric modelling systems for the extensive documentation involving the development of compatibility protocols and implementation of these models in immersive virtual scenarios for simulation and serious game purposes.

# REVEALING THE INVISIBLE: DIGITAL SIMULACRA AND VIRTUAL USE OF LOST ARCHAEOLOGICAL HERITAGE

After more than two decades of debate, nowadays, scientific research in the field of archaeology involves not only the application of the natural sciences but also the support of the latest information technology. As a result, archaeological excavations and virtual archaeology have become part of a unified methodological and cultural process, enabling the production of numerous digital outputs, thus providing a clear understanding of the data obtained from excavation campaigns. Focusing on the topic of archaeological representation, the contemporary scientific debate is currently addressing the development of an accurate methodological protocol regarding the implementation of digital visual simulation of antique contexts. The critical issues related to the digital representation of archaeological contexts are heightened in the case of " invisible" landscapes, i.e., landscapes that are no longer accessible or no longer exist and whose documentation took place in recent times carried out through analogue tools and under emergency conditions.



Digital models, used as valuable cognitive tools, complemented with the latest immersive virtual reality technologies, provide the opportunity to recreate and explore an archaeological excavation whose placement within its original landscape is no more visible, as it belongs to a dynamic environment that changes over time. The greatest challenge lies in understanding these transformations and in the digitally graphic translation of the archive material, which is not always spatially and temporally relocatable within the original scenery. The activity of graphically synthesising information is aimed at defining new communication strategies for the narration of inaccessible sites through the development of virtual applications whereby drawings and textual content become interactive. As a result of the operational workflow, the digital product is not just a mere representation in a virtual world but becomes a valuable tool for further research, as well as for promoting awareness and reconnection with the past by imbuing the space with new meanings.



## ANDREA LUMINI

University of Florence (UNIFI) – Department of Architecture (DIDA) – Florence.

Architect, PhD Candidate in "Architectural and Environmental Survey and Representation" at the Department of Architecture (DIDA) of the University of Florence.

Since 2018, he has been a research fellow at the LRA Lab of the University of Florence, dealing, within many national and international projects, with activities related to the metric-morphological documentation of Cultural Heritage, its digital representation through different 3D modeling methodologies and the development of virtual systems for management and immersive fruition.

His research furthermore focuses on Scan-to-BIM information management methodologies and ICT-related interactive and communicative virtual systems, such as XR, VPL and real-time ArchViz.

PROJECT AURA: ACOUSTIC SIMULATION OF THEATRE HALLS. FROM DIGITAL SURVEY TO VIRTUAL RECONSTRUCTION

The issue of acoustics is an increasingly debated topic in the fields of digital documentation and Cultural Heritage preservation, especially in contexts such as theater halls, churches and auditoriums. These acoustic characteristics change over time and thus contribute to structuring the historical memory of a place, playing a fundamental role in the perception and fruition of the built environment. Indeed, the acoustics of an architecture is an intangible consequence of its construction and the design choices made on the materials and furnishing systems that will constitute the truly tangible elements of the Architectural Heritage.

On these theoretical aspects has thus moved the European project AURA - Auralisation of Acoustic Heritage Sites Using Augmented and Virtual Reality, co-funded since 2021 by Creative Europe, whose aim is to explore the potential



## FEDERICO CIOLI

University of Florence (UNIFI) – Department of Architecture (DIDA) – Florence.

PhD and Research Fellow in Architecture at the University of Florence, expertise in historical research, digital survey, and cataloging of architectures and cities.

His research focuses on the relationship between Intangible and Tangible Cultural Heritage and on developing strategies for documentation and enhancement.

Since 2017 he has been the technical coordinator for the project "A documentation program for historic shops in Florence". Since 2021 he has been part of the UniFi research team in the European project that was the winner of the Creative Europe 2020 call entitled "AURA - Auralization of acoustic heritage sites using Augmented and Virtual Reality".

of auralization - a technique for simulating the acoustics of a given place within models - by combining it with the three-dimensional-visual representations of the virtual environment based on accurate digital surveys. For this purpose, three emblematic European case studies were thus examined - the Konzerthaus in Berlin (DE), the Teatro del Maggio Musicale Fiorentino in Florence (IT) and the Opera and Ballet Theater in Lviv (UA) - for each of which an appropriate methodology dedicated to digitization and virtual reconstruction was conceived, with the aim of obtaining reliable assets on which subsequent auralization processes could be set and, following these, to develop multisensory, reliable and high-performance 3D models both in terms of graphic rendering and virtual fruition, and in terms of acoustic simulation.



## MARIANNA CALIA

University of Basilicata (UNIBAS) – Department of European and Mediterranean Cultures: Architecture, Environment and Cultural Heritages (DiCEM) – Matera.

International PhD (Doctor Europaeus) in "Architecture and Urban Phenomenology".

Assistant Professor (RTDb) in Drawing (SSD-ICAR/17) at University of Basilicata – DiCEM – Matera. Winner of research grants in Europe and China, she worked at South China University of Technology, Guangzhou Urban Planning and Research Center and at Fuzhou University-School of Architectural and Urban Rural Planning. Visiting Professor in Spain at Universidad Politécnica de Madrid, Escuela Técnica Superior de Arquitectura, Universidad de Castilla la Mancha, Escuela Politécnica de Cuenca and at Universitat de les Illes Baleares. She Participates in numerous conferences, research projects and scientific publications on the topic of knowledge and survey for regeneration and rehabilitation of architectural heritage in fragile territories.

FROM SURVEY TO SIMULATION OF A VIRTUAL SPACE: UNESCO WORLD HERITAGE SITES IN SOUTH EAST CHINA AND ARCHAEOLOGICAL HERITAGE IN BASILICATA

The different researches presented in this contribution are the result of long time cooperation with two national and international partners: Fuzhou University in China and the School of Specialization of Archaeological Heritage in Matera. Chinese case studies are both part of the UNESCO Mixed Heritage Site of Mount Wuyi. The first, Chengcun Han City, is a large archaeological site to be surveyed and put in value.

The second case study regards the "cliff-burial", which was an ancient funerary ritual once popular in the Far East, during which the dead were buried high on the cliffs overlooking rivers. The log coffins (called "hanging coffins") were used to be left in the natural caves, excavated grottoes, or on some woodpiles.

Due to their size and impervious location, these were a good starting point to explore the feasibility of combining digital survey methods with tilt photography and remote sensing technology.

European case studies in Greece and Basilicata focus on graphic documentation for archaeological, artistic and mo-



### MARGHERITA TRICARICO

University of Basilicata (UNIBAS) – Department of European and Mediterranean Cultures: Architecture, Environment and Cultural Heritages (DiCEM) – Matera.

PhD in "Cities and landscapes: architecture, archaeology, cultural heritage, history and resources". Research Fellow at "Città Metropolitana di Bari" – Polytechnic University of Bari.

Tutor in Laboratory of Project 2: Representation of Architecture at University of Basilicata – DiCEM – Matera. Her research activity is focused on documentation, survey and architectural representation of national and international archaeological heritage: Satrianum and Grumentum – Basilicata; Karabournaki - Thessaloniki; Kastri-Pandosia - Epirus.

She participates in numerous conferences and research projects on the topic of knowledge and survey for enhancement and fruition of archaeological, artistic and monumental heritage.

numental heritage with the aim to experiment Virtual Archaeology and Virtual Restoration. The research is the result of a Ph.D. thesis which has experimented original methods of documentation, archiving, visualization and put in value of heritage, to know, interpret and disseminate the human past in a more complete and critical way.

To tackle the problems caused by the size and location of the site, the current study thus aims to The orthophotos lead to the creation of an ABIM (Archaeological Building Information Model). The value hierarchy established based on social network analysis provides new ideas for archaeological surveying and constructing an unmanned remote sensing monitoring system for large sites.

Hence, the conventional 3D survey means is less practical. This study explores the possibility of using UAV (consumer–level drones) in the survey with substantial improvement in accuracy, range and flight control, and compares the accuracy effects of different measurement methods.



### SOFIA MENCONERO

Roma Tre University – Department of Architecture – Roma.

She graduated with honours in Architecture at the University of Florence in 2009. In 2013 she attended a post-graduate course (master) in Open Source Technologies for Cultural Heritage at the GeoTechnology Centre of the University of Siena. Since 2021 she has been PhD in History, Representation and Restoration of Architecture at Sapienza University of Rome. She became a research fellow at the Department of Architecture of Roma Tre University at the end of the same year. She mainly works on urban and archaeological surveys, reconstruction of unbuilt architecture, experimentation with spherical visualisation, AR and RTI, and perspective analysis of Piranesian views.

## SIMULATION OF SPACE IN PIRANESI'S CARCERI BETWEEN ARCHITECTURE, PERSPECTIVE AND PERCEPTION

Perspective restitution alone is insufficient to achieve a three-dimensional simulation of the represented space in perspective images constructed without projective rigour, such as Piranesi's Carceri. Therefore, a method of spatial analysis - that integrates architectural (graphic analysis), perspective (perspective restitution and principle of sceno-graphy), and perceptual (eye-tracking technique) interpretations - is proposed and then applied to the frontispiece of the first edition of the series. The result is a three-dimensional simulation of Piranesi's space, whose perspective view can be compared with Piranesi's perspective. Further axonometric views of the 3D model show the architectural elements directly derived from the engraving, those varied for architectural-compositional reasons and those assumed to complete the space.





## ELISABETTA CATERINA GIOVANNINI

Polytechnic of Turin (POLITO) – Department of Architecture and Design (DAD) – Torino.

Assistant Professor at the Department of Architecture and Design (DAD) of Politecnico di Torino. She specialized in the digital acquisition, documentation and critical analysis of the architectural and archaeological heritage using the latest computer technologies, tridimensional models and digital environments. Her research interests are related to the disciplines of drawing, survey and digital representation of architecture. In recent years she has dealt with the use of IT applied to CH. She investigates the use of ontologies, BIM and H-BIM platforms to manage virtual reconstruction processes and digital collections for museums.

DIGITAL ECOSYSTEMS FOR THE VIRTUAL ANALYSIS OF PORTA AUREA IN RAVENNA

The presented study is focused on analysing architectural representations through computational and digital methods in a context of transversality and trans-disciplinary knowledge. In particular, the study enlightens the role of digital ecosystems in the communication processes of built cultural heritage, which is intended as a medium for the visualization of the n-dimensional levels of knowledge that can be collected in virtual reconstruction processes according to different kinds of resources.

The study involves different applications and tools for creating digital ecosystems that manage diverse information: digital galleries, 3D models, drawing annotation systems and H-BIM platforms.

Starting from the digital acquisition of archaeological evidences and fragments of Porta Aurea in Ravenna, a Roman Gate, built in 43 A.D. with the behest of roman Emperor Tiberius Claudius, that is a no longer extant monument that has always aroused the interest of many scholars and archaeologists, the existence of large and not heterogeneous

Gate, built in 43 A.D. with the behest of roman Emperor Tiberius Claudius, that is a no longer extant monument that has always aroused the interest of many scholars and archaeologists, the existence of large and not heterogeneous documentation available allows the possibility to investigate the theme of interpretative processes and their management trying to close the gap between original data and associated interpretations.

Clarifying the relationship between research sources (collection and acquisition), implicit knowledge (analysis), explicit reasoning (interpretation), and 3D visualization-based outcomes (data representation and visualization) can be very useful in the case of historical reconstructions of architectural projects never built, no more existing or partially documented.

The presence of a room dedicated to the Porta Aurea fragments at the National Museum of Ravenna also offers new perspectives on the use of digital twins for managing museum collections.

## Session 2 Information Databases and Information Systems for Architecture

# keynote speaker



## MARCO MORANDOTTI

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University of Pavia (UNIPV) - Department of Civil Engineering and Architecture (DICAr) - Pavia.

Full professor of Architectural Engineering at the University of Pavia. Vice Director of the Department of Civil Engineering and Architecture of the University of Pavia; Vice President of EDiSU Pavia; Chancellor's delegate for the building heritage of the University of Pavia. President of the Degree Course in Building Engineering and Architecture. He has been Director of the Interdepartmental Centre for the Conservation of the Historical Heritage of the University of Pavia and Coordinator of the Ph.D. Course of "Building Architecture". He is responsible for the scientific activity of the STEP laboratory in the DICAr since 2002. Has coordinated national and international researches mainly focused on the following topics:

- knowledge based conservation of the historical heritage,
- territory assessment for sustainable tourism strategies development
- sustainable design in developing countries,
- 4. hospital design and healthcare planning

> CULTURAL HERITAGE DIGITAL ASSET MANAGEMENT: A FORTHCOMING REVOLUTION

General aim of Asset Management is to achieve the organizational objectives through balancing risk, opportunities and costs. It has become more and more relevant, both for producing value through management of the built environment and for supporting the sustainability strategies, while the market is shifting from selling products to selling services. Its relevance may become even greater if we take into consideration Cultural Heritage assets, due to the more crucial balancing among historical values, improvements requirements and conservation constraints.

Nowadays, following the trend of the digital revolution, the increasing adoption of Information Technologies pushes for a transition from the traditional Asset Management to the Digital Asset Management. This happens by means of the in-



tegration among different digital technologies, from survey and documentation, to modelling, to management of existing structures, including planned conservation strategies and resilience planning tool through sustainable adaptive reuse. We shall consider "digital" asset management not only as a simple translation of traditional asset management in a digital environment, but we are expected to analyse how asset management strategies and tools may interact with even more pervasive ICT disruptive technologies, in order to reach a new level of integration, efficiency and effectiveness in the perspective of and increasing integration of the previously described functional, energetical and life cycle oriented sustainability.

# keynote speaker



## BOGUSŁAW SZMYGIN

Lublin University of Technology – Built Heritage Department – Lublin.

Head of Built Heritage Department; Dean of Civil Engineering and Architecture Faculty LUT (2005-12; 2016+).

He specializes in protection and conservation of architectural monuments (theory of conservation, revitalization of historical towns, protection and conservation of architectural monuments, World Heritage issues, protection of historic ruins).

Author of over 150 scientific articles (e.g monograph "Development of conservation doctrine in Poland in XX century"; "UNESCO World Heritage – Methodology and Management"); organizer of several scientific conferences, scientific and educational programmes; scientific editor of dozen proceedings; author of over 50 screenplays for educational films.

President ICOMOS Poland (2008+17; 2021+); President of ISC TheoPhil (2017+).

> HERITAGE BIM - TOOL AND METHODOLOGY

Digital technology allows you to combine digital tools (collecting data) and design software into one process. This is very important in the protection of monuments, because is a discipline that requires a combination of architectural and technical issues. Thus, the HBIM methodology (based on BIM) will allow to comprehensively organize/link the stages and elements (technical and architectural) of the monument protection process.

The starting point for presenting the possibility of developing the HBIM methodology should be a synthetic presentation of key elements and stages in the process of monument protection. From the perspective of the characteristics of the BIM system, it can be considered that the process of monument protection consists of two groups of activities: "preparatory activities" (generally intangible) and "implementation activities" (material).

Preparatory actions consist: 1. Inventory of the historic object; 2.Documentation of the historic object; 3. Technical examination of the state of preservation of the object; 4.Design and planning of conservation, renovation and adaptation works. Together, these four groups of activities form a very important group of "preparatory actions" as part of the monument protection process. The paper will discuss three main issues relevant for development of HBIM methodology. Firstly, why the very important elements of the heritage protection process (called "preparatory actions") need to be combined (within HBIM)? Secondly, how can elements of the monument protection process (preparatory activities) be organized under the HBIM method? Thirdly, what are the additional possibilities resulting from the combination of elements of the monument protection process (preparatory activities) into the HBIM method?



## FABIANA RACO

University of Ferrara (UNIFE) - Department of Architecture - Ferrara.

PhD in Technology of Architecture, Researcher RTDa (ICAR /17) for the Department of Architecture, University of Ferrara, Italy.

She is member of the research centre DIAPReM Development of Integrated Automatic Procedures for Restoration of Monuments, University of Ferrara, and member and Technical Coordinator of TekneHub Laboratory, University of Ferrara, Technopole of Ferrara, Emilia-Romagna High Technology Network. She is co-founder of the spin off Raise>Up of the University of Ferrara.

Her areas of investigation are 3D surveying, drawing, digital documentation and representation, 3D modelling, HBIM for Cultural Heritage and built heritage, as well as integrated digital technologies, such as KET's, for industrial research activities. In the same fields of research, she is scientific responsible of research activities in Italy and abroad.

DIGITAL DOCUMENTATION FOR THE ENHANCEMENT OF BRAZILIAN CULTURAL HERITAGE; MUSEO DO IPIRANGA, PARQUE DA INDEPENDÊNCIA AND MONUMENTO À INDEPENDÊNCIA.

For this year's bicentenary of Brazil's independence, the DIAPReM research centre and the TekneHub laboratory of the University of Ferrara present the results of the digital documentation of one of the most important monumental complexes in the state of São Paulo: Museo Do Ipiranga, Parque da Independência and Monumento à Independência.

The application of integrated three-dimensional survey protocols and scan-to-HBIM procedures currently provides technicians, researchers, public administration, and citizens with the most complete digital memory of the monumental complex built by Italian architects and engineers in 1922, on the occasion of the centenary of the country's independence. Moreover, the database represents the documentation of the state of the museum before the recent restoration work. The survey databases and HBIM models are finally an inherent part of the valorisation and dissemination project, intended for an audience of non-professionals only, IpirangaDigital.





## **FAUSTA FIORILLO**

Polytechnic of Milan (POLIMI) – Department of Architecture (ABC) – Milan.

Researcher (RTDa) at the ABC Department (Politecnico di Milano) for the ERC LIFE project (Living in a Fringe Environment). Her main research interests involve advanced surveying and representation techniques, digital model geometrical analysis and interpretation, and 3D modelling applied to Cultural Heritage and archaeological sites. Engineer (Salerno University), PhD in Architecture and Urban Phenomenology (Basilicata University), he has participated in numerous projects as a research fellow at the DICIV (Salerno University) (PRIN, FARB, Grande Progetto Pompei). She collaborated with national/international universities and research centres (LFA - Valladolid University - Spain, 3DOM - FBK – Trento, Cordoba National University - Argentina).

> DATA MANAGEMENT, EFFICIENT USE AND ENGAGING FRUITION OF REALITY-BASED MODELS VIA WEB PLATFORMS

Sharing the output data of a digital survey with other stakeholders can increase its professional and widespread use. In most cases, the most challenging problem is how a user who is not a surveyor can visualise/interrogate/ measure the reality-based models in the three-dimensional space - and not only- without sector-specific software. The possibility to upload digital data on online platforms allows diffusing and exploiting the potentialities of the 3D survey technology. The point cloud can be investigated directly on the web and accessible on any device (laptop, desktop, tablet, or smartphone). Standard features include measuring, cropping, annotating, and downloading data. Moreover, the different commercial proposals provide many innovative functions: VR interaction, BIM interoperability, 3D point cloud automatic segmentation. This solution constitutes a real revolution for digital data sharing

among technicians and professionals, who can dispose of all the surveyed information directly on their devices anytime, anywhere.

The discussion aims to present the characteristics and potential of some web platforms for direct sharing and management of the point clouds from image- or range-based surveys. Preliminary research to underline the pros and cons and identify future developments of this new way of exploiting digital survey data is presented.

This approach can be advantageous in the Cultural Heritage field, especially when CAD or HBIM modelling is not needed because is not the final aim. The solution can be to skip the complex and time-consuming modelling phase altogether and use the point cloud directly as a 3D geometric base and for the information repository.



## **RAFFAELE CATUOGNO**

University of Napoli Federico II (UNINA) - Department of Architecture (DiARC) - Napoli.

Architect, PhD, is Associate Professor in the Scientific Sector ICAR/17. As expert in 3D and integrated surveys for the documentation and diagnosis of architectural heritage, he has experimented with operational and methodological applications in different national and international contexts and has developed skills in the area of research project development. He is the author of many articles and papers in journals, contributions in volumes and conference documents.

> DIGITALIZATION FOR HERITAGE: A COGNITIVE PLATFORM FOR SMART COMMUNICATION

The paper describes a pilot experiment that aims to represent the contribution that basic academic research can provide to the construction of a smart community where cultural heritage acts as a driver for a model of local development in the territory. The idea is that of a cognitive platform based on processes of mapping the architectural/ archaeological heritage apt to understand its material and immaterial consistencies through the construction of a cognitive system that, moving from the collection of data on individual buildings to the three-dimensional representation of the cultural heritage, allows for its remote enjoyment and/or enriches the physical and direct experience. The difficulties of direct controlling the countless finds in the territory produces the need to develop a communication project to identify/localize each individual find and link it to information that allows its fruition in its different aspects.



Starting from the territorial mapping and survey of example sites, the present work aimed to experiment with the possibilities of representation and knowledge of reality (territorial, architectural, archaeological) and to develop the connections between the different experiential modes as in a kind of three-dimensional hypertext.

The information collected on sites through surveys and sorted through a graphic display produced a vast and diverse documentation that guided the development of the framework for cataloging, management and geolocalized visualization of architectural/archaeological artifacts and sites.

The exposition of the operational methodologies adopted and the results obtained are intended to serve as an incisive demonstration of the strategic role assumed by digital technologies in today's knowledge society.



## PAMELA MAIEZZA

University of L'Aquila (UNIVAQ) – Department of Civil Engineering and Architecture – L'Aquila.

Master's degree in construction-Architectural Engineering in 2014, the 2nd level University master's degree in Architectural Design for the Restoration of Historic Buildings and Public Spaces in 2016. She is Ph.D. in Civil, Construction-Architectural, Environmental Engineering, since 2019. After obtaining the National Scientific Habilitation as associate professor in the sector 08/E1 DRAWING in the 2018-2020 session, she is currently assistant professor at the University of L'Aquila. Her research activity concerns survey, architectural representation, 3D modeling, BIM and HBIM, and documentation and communication of architectural heritage. She is Journal Manager of the scientific journal "DISEGNARECON" (ISSN 1828-5961).

## > 3D Models for Architectural Heritage Documentation: Transparency and Reliability Issues

Digital modeling has multiplied the possibilities offered by graphic representation for the study, analysis, documentation, and enhancement of the architectural heritage. In particular, 3D models, intended both as a visual computing tool -that is, data processing and deepening of the characteristics of buildings - and as "complex" models -as they are connected to a heterogeneous information system- favor the documentation of the historical and architectural values of the heritage. In this context, Building Information Modeling (BIM), in its dual meaning of graphic representation and database, has amplified such potential, offering itself as an interactive platform where to manage the heterogeneous and multidisciplinary information inherent to the architectural heritage. However, these models are not a complete and exhaustive transcription of the characteristics of the object of study, but rather a critical selection of these, made



according to the purposes of the representation and the specificities of the architectural object. For this reason, in order for the representation to have a scientific basis, it is necessary that the sources used for the realization of the model are declared transparently and that the interpretative level of the virtual reconstruction is clear. The contribution deals with the issues of transparency of models and their reliability, in relation to both geometric and non-geometric contents. In particular, based on an experiment conducted on several case studies, it proposes a possible specific procedure for modeling transparency and reliability evaluation, necessary for the documentation of the architectural heritage through 3D models.



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Ph.D. candidate in Design, Modelling and Simulation in Engineering at the High Doctoral School of University of Pavia and Contract Professor at University of Pavia in "3D database survey and management activities". Her research areas concern analysis of protocols and methods for the management and conservation of historic buildings, analysis of urban agglomerations, documentation and digital survey of historic territories and cities and management of databases. Since 2018, as research fellow, she has participated in national and international research projects for historical, monumental and UNESCO sites.

DATABASES AND DRAWINGS TO SUPPORT THE DEVELOPMENT OF THE DOCUMENTATION PROJECT. THE CASE STUDY OF «LE TORRICELLE» IN VERONA

The research concerns a process of documentation and analysis for the development of guidelines useful for the conservation, maintenance, and enhancement of a portion of the Magistral Walls of Verona. Within an agreement between the Municipality of Verona and the University of Pavia, numerous documentation campaigns were developed to define an overall knowledge of the diagnostic conditions of a 300 m portion from the 11 km boundary of the mediaeval Scaliger's wall.

The goal is to define, through a dialogue with the superintendence, standard identifications of documentation and conservation approaches. It regarded the integration of multiple phases of digital documentation for morphome-tric drawing and 3D modelling, to support mineralogical, petrographic, archaeological, geo-seismic, endoscopic,



structural and design evaluations for restoration and conservation. It has been possible to cross-reference data on the construction and technological characteristics with aspects relating to the documented conditions of degradation, generating synthesis frameworks useful for guiding the conservation interventions on typological and formal classifications of the fortified system. The aspect of interest, however, is not only the quantitative richness of the data but the fact that this can be queried in the same database. All this is related to the idea of sustainability of the knowledge process and optimization of resources and costs. The ambition of the work is to define, together with the stakeholders of the city of Verona, an exportable protocol calculated to be sustainable over the entire extent of the walls of Verona, UNESCO World Heritage site.



## ANDREA DI FILIPPO

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European PhD in Risk and Sustainability in Civil, Architectural and Environmental Engineering Systems at the Department of Civil Engineering, University of Salerno. Graduated with honours in Architecture and Building Engineering. From September 2017 to June 2018, he was invited by the University of Salaranca as Visiting Research, taking part in two European projects. He was selected for two international missions: in July '18, in South Africa, for the Project "A Social and spatial investigation at the Moxomatsi village, Mpumalanga"; in February '20, in Colombia, for the Project "Revealing/detecting the future". He is Adjunct Professor of Digital Modelling at San Raffaele University in Rome for the academic year 2021/22.

# TRACEABILITY OF GEOMETRIC ATTRIBUTES IN BIM MODELS FOR THE HERITAGE DOCUMENTATION

The presented contribution follows two lines of investigation:

• the first is related to the technical aspects of BIM applied to existing constructions. The main purpose is to formalize a procedural pipeline for reverse engineering implementations, especially with Scan-to-BIM techniques. Although the literature is rich in contributions analysing this topic, an organic treatment is lacking and there are many punctual experiences, related to the contingencies of the case study. Instead, our approach aims to generalize the results of applications and contribute to the outline of a best practice for the management of data derived from digital surveying. The proposed solutions attempt to foresee possible scenarios and offer valid alternatives to ensure a holistic treatment of the methodology;



• the second line of research focuses on the topics of data reliability and accuracy. The possibility of updating and reusing a model depends on precisely these two factors and, despite this, there is a lack of a unified framework to solve this critical issue. As far as the first topic is concerned, valid solutions emerge from the literature, but they struggle to establish themselves because they are not well integrated within the tools outlined by the technical standards. For this reason, our proposal for assessing reliability does not introduce any further novelties, but aims to seek out solutions already used in parametric modelling or related fields. Turning to the subject of accuracy, we suggest differentiated frameworks for survey operations and source-based virtualization, focused on statistical data processing and implementable in any workflow.