



DIPARTIMENTO DI STORIA CULTURE CIVILTÀ



## ***New Frontiers in Digital Field Archaeology. Reshaping Practices through Digital Strategies***

**June 6th, Department of History and Cultures, University of Bologna, Aula Gambi**

### ***Program***

#### **First Session: Digital and Theoretical Archaeology**

Moderator: Andrea Augenti.

- **9:30** - Roberto Balzani, (University of Bologna, Head of DiSCi), Welcome.
- **9:40** - Nicolò Marchetti (University of Bologna, Coordinator of the Section of Archaeology at DiSCi), Opening Remarks.
- **9:50** - Marco Cavalazzi (University of Bologna), Introduction to the workshop: "Digital Strategies and Field Archaeology. Methods and Theory".
- **10:10** - Andrea Augenti (University of Bologna), Introduction to the morning session.
- **10:30** - Cristiano Putzolu (University of Bologna), "3D Survey of the Archaeological Evidence. Some Reflections about Scale, Accuracy, and Observation" (ONLINE).
- **10:50** - Break.
- **11:20** - Giacomo Landeschi (Lund University), "Challenging the Paradigms of Site Documentation. High-Definition vs Multi-Resolution Approaches".
- **11:40** - Tyler Johnson (University of Michigan), "3D Survey and the Digital Field-to-Publication Pipeline at the Gabii Project".
- **12:00** - Enrico Ferraris (Museo Egizio of Turin), "Conversing with Objects in the Post-Digital Age. A Museo Egizio Case Study".
- **12:20** - Discussion.

**12:45** - Lunch Buffet.

#### **Second Session: New Field Applications of Digital Archaeology**

Moderator: Nicola Terrenato.

- **14:30** - Nicola Terrenato (University of Michigan), Introduction to the afternoon session: "Perspectives for the Digital Analysis of Complex Stratification".

- **14:50** - Giuseppe Guarino (University of Bologna), “The Impact of Digital Technologies on Field Survey. Is Our Approach to Archaeological Data Collection and Management Effective?”.
- **15:10** - Alberto Urcia (Yale University) and Elisa Brener (3Delta Creative), “Digital Epigraphy and Beyond. Was Technology Able to Improve the Research on Egyptian Rock Art and Inscriptions?” (ONLINE).
- **15:30** - Francesca Bindelli (University of Bologna), “Preliminary Study of the ‘Tappatino’ Area of Suasa through the Extended Matrix Framework. From Harris Matrix to Virtual Reconstruction”.
- **15:50** - Maria Laura Leonardi, Daniel Oliveira, and Miguel Azenha (University of Minho), “HeritageBIM. Current Developments and Challenges” (ONLINE).
- **16:10** - Break.
- **16:40** - Final Roundtable.

[Register Online here](#)

## ***Abstracts***

### **First Session: Digital and Theoretical Archaeology**

Moderator: Andrea Augenti (University of Bologna)

#### **3D Survey of the Archaeological Evidence. Some Reflections about Scale, Accuracy, and Observation**

Cristiano Putzolu\*.

\*University of Bologna.

In terms of the technologies involved, there is no doubt that the digital revolution has taken archaeological survey to the 'next level', but are we sure that we are also at the 'next level' in terms of outputs?

My talk will try to highlight the different moments in the production of the archaeological record that are involved in the survey: data production (excavation continuously destroys and creates the archaeological record at the same time) in the field, data acquisition, and data reproduction in digital environments.

In each of these moments there are several operations that archaeologists often perform quite automatically, sometimes without fully considering one of the most important aspects of the digital environments in which the acquired data will be processed and experienced: their absolute ease of change of scale.

GIS, BIM, VR/AR environments can make our survey visible at different scales in a matter of seconds, and our reproduction of archaeological evidence must always reveal its informative value.

It's in the attention to the informative value of the "digital twin" of our archaeological context that I think most of the problems we face as a community lie.

Too often we are driven to seek the greatest accuracy, relegating to a second level the accurate observation of our context and the recognition of the various elements that make it up.

The result is that archaeological projects build TBs of digital archives with hundreds of highly accurate 3D models of their excavated contexts, but rarely are the point clouds transformed into digital features that are 'semantically enhanced' with the qualitative data recorded for the context itself.

The reasons for such a situation are many: the processing of the survey left for the off-season, the lack of communication between surveyors and excavators, the lack of a precise plan for the "post-processing" phase.

## **Challenging the Paradigms of Site Documentation. High-Definition vs Multi-Resolution Approaches**

Giacomo Landeschi\*.

\*Lund University.

In a typical archaeological investigation, site documentation represents a pivotal element of the hermeneutic process. Strategies of data collection, mediated by a plethora of techniques and methods, can dramatically affect the process of understanding and interpreting an archaeological sequence. In recent years, due to significant advances in computational (hardware and software) performance, the term high-definition archaeology has been introduced to describe all the methodological approaches focused on managing the massive amounts of data collected during fieldwork (trench excavation).

Although the importance of a high-definition approach must not be underestimated, it is important to question its theoretical and methodological implications. What kind of definition are we talking about? What is the ideal definition? What is the role of scale in data representation? To address these issues, we propose a more comprehensive definition: the multi-resolution approach, where multiple data sources with variable degrees of definition better meet the needs of archaeologists to cope with the complexity of a stratigraphy to be documented. To this scope, a few case studies are presented and discussed.

### **3D Survey and the Digital Field-to-Publication Pipeline at the Gabii Project**

Tyler Johnson\* .

\*University of Michigan.

The integration of 3D field recording, particularly structure-from-motion photogrammetry, has become essential in archaeological workflows. Over the past decades, there has been significant experimentation and debate regarding various methods of deploying the 3D data gathered in the field. These methods range from integrating 3D models into existing datasets using GIS or similar technologies to creating immersive reconstructions with game engines. Despite these advances, archaeologists still lack actionable workflows for publishing 3D data in peer-reviewed formats. This talk examines the approach of the University of Michigan's Gabii Project to these challenges. I begin with an overview of some general trends in 3D approaches in past decades at the intersection of theory and practice, before offering a consideration of the state-of-the-art. This is followed by a discussion of the Gabii Project's digital toolset for field data recording, with a focus on how our approach responds to theoretical and methodological challenges. To illustrate this, we explore the project's achievements in peer-reviewed, open-access publication, focusing on volume 2 of the *Gabii Project Reports*. This publication uniquely combines hyperlinked text, a 3D interface designed in the game engine Unity, and an underlying database. I conclude with a discussion on the impact of these publications, the responses they have garnered, and future directions in the Gabii Project's commitment to digital publishing.

## **Conversing with Objects in the Post-Digital Age. A Museo Egizio Case Study**

Enrico Ferraris\*.

\*Museo Egizio of Turin.

The evolution of technology has shaped our world in unimaginable ways over the past few decades. The digital age marked a momentous turning point, radically transforming society, the economy, and culture. Following this, the post-digital era signifies a shift from the initial shockwave of the technological revolution to critical reflection on the resulting changes and new paradigms. This era transcends the "old vs. new" dichotomy, profoundly transforming our lives and the objects around us. Unlike the disruptive approach of the digital age, the post-digital phase emphasizes a deeper and more integrated incorporation of the latest technological advancements into our daily lives. In this new technological landscape, the traditional barrier between the real and the digital increasingly reconfigures into a seamless continuum. This emerging intangible or conceptual space, born from the interaction between the digital and physical worlds, defines new cultural, social, and economic paradigms and technological approaches, broadening and enriching our understanding of the world.

Digitization has significantly impacted museums at multiple levels, including structures, systems, processes, and collections. The digitization of collections and recent scientific material investigations, as part of extensive archaeometric campaigns, have generated a critical mass of data. Integrating these multiple layers of data about a single object reveals elements of its specific history: from production to use, abandonment to rediscovery, decontextualization during excavation to re-contextualization in a museum, and finally, its subsequent conservation and media history. In other words, it illuminates the biography of the object.

This paper will discuss the integration of the humanities and natural sciences into a holistic vision that increasingly connects research and dissemination as parts of a unified cultural trajectory at the Museo Egizio. From the introduction of archaeometry as a research axis in 2015 to significant case studies such as the "TT8 project" and the 2019 exhibition "Invisible Archaeology," the paper will highlight how these efforts have shaped a cohesive approach to studying and narrating the Museo Egizio's collection.

## **Second Session: New Field Applications of Digital Archaeology**

Moderator: Nicola Terrenato

### **The Impact of Digital Technologies on Field Survey. Is Our Approach to Archaeological Data Collection and Management Effective?**

Giuseppe Guarino\*.

\*University of Bologna.

The integration of digital technologies is transforming archaeological field survey practices, offering unprecedented improvements in data recording, analysis, and interpretation. Smartphones and tablets have become essential tools, enabling real-time collaboration and seamless data sharing. Despite these advancements, critical challenges persist in ensuring the accuracy and reliability of collected data, particularly in spatial recording and its subsequent analysis.

This presentation explores these challenges through a case study conducted on the periphery of the Roman city of Suasa, in Ancona, Italy. Traditional survey methods, involving a grid system with 10-metre squares, were complemented by mobile FLOSS GIS applications to map and record surface finds. The training and experience of surveyors played a crucial role in data consistency. Statistical analyses of the data revealed significant discrepancies among different surveyors, underscoring the need for robust training programs and standardised methodologies to ensure data integrity.

This presentation will discuss the implications of digital integration on data management and interpretative accuracy. It will examine whether current digital approaches adequately address the inherent complexities of archaeological data collection or if they introduce new challenges. Emphasis will be placed on the balance between technological capabilities and human expertise, advocating for a synergistic approach that enhances data reliability and interpretative clarity.

By critically assessing the impact of digital technologies on field investigations, it is intended to contribute to a more careful evaluation of the use of technologies and their effectiveness. It seeks to foster dialogue on improving training, standardisation, and methodological frameworks to optimise the benefits of digital tools in archaeology.

### **Digital Epigraphy and Beyond. Was Technology Able to Improve the Research on Egyptian Rock Art and Inscriptions?**

Authors: Alberto Urcia\* and Elisa Brener\*\*

\*Yale University

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Over the past twenty years, the application of digital technologies to archaeology and cultural heritage studies has exponentially grown, reaching a predominant role within the disciplines. Excitement and innovation often led a large part of researchers struggling in understanding from one end, how to handle the increasingly large amount of data that technology produces, and the other end, how to take advantage of it to produce new

information and knowledge for research. This workshop is a proof that the debate on this matter is still open even though, at the same time, it is suggesting a much brighter situation. While waiting to hear experiences and feedback from the other attendees and their areas, with this abstract we anticipate that digital technology certainly had a positive impact on epigraphic studies, and especially in the documentation of rock art and inscription sites. In our presentation we will offer an overview on the methodology that Yale Egyptology, together with other affiliated projects, was able to build during the past fifteen years of research, combining photogrammetry, topography, archaeology, philology and recently, computer graphic. From the experimentation, it was interesting to see the potential of adding more advanced and specialised computing techniques into the research pipeline. The idea here is to make a technical review of the digital epigraphic methodology, focusing on those aspects which have been significantly influenced by technology and see how they have improved and changed overtime.

### **Preliminary Study of the 'Tappatino' Area of Suasa through the Extended Matrix Framework. From Harris Matrix to Virtual Reconstruction**

Author: Francesca Bindelli\*

\*University of Bologna

The paper discusses a reconstruction proposal of the 'Tappatino' area of Suasa (Castelleone di Suasa, AN), a farmhouse located in the Archaeological Park of the Roman city. In order to tackle the complexity of the context in exam, the study takes into account various data sources. These include archival data, archaeological research, topographic surveys using photogrammetric and laser scanning techniques, and stratigraphic analysis of the masonry. The Extended Matrix Framework (EMF), a specific part of the Extended Matrix (EM) method developed by the VHLab of the CNR ISPC in Rome, is used to reconstruct the context in its various phases, in order to facilitate the management of 3D data in the field of virtual reconstruction. The Extended Matrix (EM) is a formal language apt to keep track of the different sources used and of the analyses carried out in order to achieve a virtual reconstruction of an archaeological context. This methodology updates the stratigraphic basis of archaeology through the creation of a new Stratigraphic Unit, the Virtual Stratigraphic Unit (USV). Thanks to the Extended Matrix method, it is possible to simplify the architectural reconstruction process, to validate the workflow from data collection to modelling, and to effectively manage the 3D data, with the option of sharing the entire research process online. Thanks to this innovative approach, a new analysis of the 'Tappatino' area from the Roman Imperial period to the present day is proposed, using a transparent and reproducible reconstruction workflow. This method not only can facilitate a comprehensive understanding of the historical development of the study area, where extensive archaeological research has been hindered, but also allows reflection on communication and valorisation within this context, made difficult by its multi-stratified nature.

## **HeritageBIM: Current developments and challenges**

Authors: Maria Laura Leonardi \*, Daniel Oliveira \*, and Miguel Azenha\*

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Building Information Modeling (BIM) is a methodology for creating, managing, and utilising information throughout a building's entire life cycle, from initial design through construction, operation, and eventual decommissioning. BIM fosters a collaborative approach to building design and construction, allowing architects, engineers, contractors, and owners to work together within a shared digital environment. This integration facilitates better decision-making, reduces errors and rework, and enhances overall project efficiency and quality [1]

Government mandates in various countries have accelerated the adoption of BIM by setting requirements for its use in public sector projects. Furthermore, the development and implementation of open standards, such as Industry Foundation Classes (IFC) and the BIM Collaboration Format (BCF), have facilitated seamless data exchange among different software platforms and stakeholders. These open protocols ensure that BIM data is interoperable, enabling diverse teams to collaborate effectively without being constrained by proprietary software limitations [2], [3].

The term Historic Building Information Modeling (HBIM) denotes the use of BIM methodology to heritage buildings [4]. Scientific literature highlights various HBIM applications, including geometric surveys, damage assessments, structural evaluations, facility management, and rehabilitation.

While the benefits of BIM in the context of historic buildings are significant, there are also unique challenges to overcome [5]. One of the major issues is the accurate geometric modelling of historic structures, which often have complex, non-standard shapes. Traditional BIM tools designed for contemporary, standardised constructions are inadequate for this complexity. To address this, advanced data acquisition methods, such as point clouds utilising laser scanning or photogrammetry, have been integrated into BIM workflows to enhance modelling accuracy and efficiency [6].

Managing non-geometric information, including historical context, material properties, and conservation records, presents another challenge. The semantic enrichment of BIM models is a critical area of research, as it embeds comprehensive information within the BIM framework. This enrichment facilitates a deeper understanding of the historic building's significance, condition, and maintenance requirements, supporting informed decision-making throughout restoration [7].

Interoperability between BIM and specialised simulation software is also a notable challenge, as historic buildings necessitate complex analyses that are not fully supported by standard BIM tools. Researchers are focused on improving data exchange protocols and software compatibility to enable comprehensive analyses and seamless integration of diverse simulation tools [8], [9].



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