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Book of Abstracts

International Scientific Conference

Multidisciplinary Research on Cultural Heritage MRCH 2025

Zagreb, 24–26 September 2025

Co-organisers: University of Zagreb – Faculty of Textile Technology, Library of the Croatian Academy of Sciences and Arts, ICARUS (International Centre for Archival Research), ERC-BP (European Research Centre for Book and Paper Conservation-Restoration), IIC (The International Institute for Conservation of Historic and Artistic Works) Croatian group.

The conference is held under the auspices of the Ministry of Culture and Media of the Republic of Croatia.

Dear colleagues and friends of science and cultural heritage,

The *Multidisciplinary Research on Cultural Heritage* conference (MRCH 2025) is envisioned as a meeting-place for scholars and professionals from various fields who are united by a shared interest in cultural heritage. The concept of cultural heritage is broad, opening the door to multidisciplinary research and allowing us to explore it using perspectives from a range of different disciplines.

The conference places a particular emphasis on new and diverse approaches to studying cultural heritage, aiming to highlight their interconnectedness. The results of previous research demonstrate that integrating content analysis with the study of the material characteristics of cultural heritage leads to a more comprehensive understanding and more complete interpretations.

Our goal is to foster dialogue between the academic and professional communities, encourage the exchange of knowledge and experiences, and promote innovative methodological approaches in the study of cultural heritage. We believe that the broad range of approaches to cultural heritage research adopted by individual researchers and experts will inspire mutual cooperation, understanding, and the sharing of knowledge.

The international scientific conference *Multidisciplinary Research on Cultural Heritage* (MRCH 2025) will be held in Zagreb for three days at four different locations.

On the first day, **24 September 2025**, the conference will open at the **Croatian State Archives at Marulićev trg 21**. This is the central archival institution responsible for collecting information on archival materials in Croatia. It is the most important palace of the Croatian Art Nouveau period, a combination of early Viennese Secessionism and modern European architecture from the beginning of the 20th century, built in 1913.

On the second day, **25 September 2025**, the conference will be held at the **Library of the Croatian Academy of Sciences and Arts**, located at **Trg Josipa Juraja Strossmayera 14**. This distinguished neo-Renaissance building, constructed in 1884 based on the design of renowned architect Hermann Bollé, originally served as the home of the Chemistry Department of the Faculty of Science and Mathematics until 2005. Today, the library holds a rich collection of rare books, manuscripts, and periodicals, including invaluable works from the early modern period and the Croatian national revival.

On the same day, **25 September 2025**, the program includes a visit to **the Museum of Contemporary Art** at **Avenija Dubrovnik 17**. It was built according to the design of architect Igor Franić. The museum opened on 11 December 2009. As a multi-program institution, it mediates heritage and the contemporary scene, ranging from visual art to performing and film art.

26 September 2025, the third day of the conference, will be held at the **Faculty of Graphic Arts at Getaldićeva 2**. Classes began in 1960 after the completion of the construction of the faculty building. The faculty is organized into six modules: graphic technology, multimedia, publishing, packaging, graphic product design, and graphic management, where 19 departments operate.

Program of the International Scientific Conference

***Multidisciplinary Research on Cultural Heritage* (MRCH 2025)**

Zagreb, 24–26 September 2025

Day 1, 24 September 2025 – Croatian State Archives, Trg Marka Marulića 21, 10000 Zagreb

9.00	Registration
9.30	Welcome Speech
9.45 – 10.45	**Post-Conflict Heritage and the Role of International Organizations in Its Protection: Afghanistan as a Case Study** Bilel Chebbi (Morocco)
	Reimagining Digital Archaeology: Unveiling Power Dynamics Through Actor-Network Theory Sayumphu Ros (Cambodia)
	The Kwagh-Hir Cultural Heritage as a Tool for Intra-Ethnic Conflict Resolution Among the Tiv of Central Nigeria Terngu Sylvanus Nomishan (Nigeria)
	Digitization of Stećci: An Interactive Approach to Medieval Funerary Iconography and Inscription Luka Ramljak (Croatia), Sara Jalimam, Bilal Softić (Bosnia and Herzegovina)
	Sponsored Lecture: Crescat
10.45	
11.00	Discussion
11.15	Exhibition Opening **Stećak: A Life in Stone**
11.30	Coffee Break
12.00 – 12.15	Guest Lecture: **StećakLand: Material Heritage Presentation Through Virtual Reality, Augmented Reality and Theatre** Dr.sc. Selma Rizvić, Vedran Fajković (Bosnia and Herzegovina)
12.15 – 13.15	**"Walnut Shell Boats", in Greece (and Everywhere)** Markaki Krystallia (Greece)
	Digital Voices from the Past: Integrating AI-Driven Speech and Avatar Synthesis for Cultural Heritage Interpretation Neda Milić Keresteš (Serbia)
	A 1725 Zagreb Pauline Antiphonary: Origins, Content, Structure, Materials, Chant Repertory Hana Breko Kustura, Jelena Duh, Vladan Desnica (Croatia)

	Advancing Modern Ink Analysis in Written and Printed Heritage: Application of MeV SIMS for Identification of Ink Colorants Matea Krmpotić (Croatia)
13.15	Discussion
13.30 – 14.30	Lunch
14.30 – 15.30	**Serpents and Saints: Iconographic Codes and Visual Theology in Yılanlı Kilise Cappadocia** Andreea Roxana Oatu (Romania)
	St Veronica, Volto Santo, and Anno Santo: Visual Testimonies of Pilgrimages Sanja Cvetnić (Croatia)
	The Beneventan Manuscript Heritage of Zagreb: Paleographic Perspectives on a History Between the Two Adriatic Shores Domiziana Piscopo (Italy)
	Ptolemy and Regiomontanus: Astronomical Works in the Corvinian Library Péter Ekler (Hungary)
15.30	Discussion
15.45 – 16.45	Tour of Select Spaces in the Croatian State Archives
16.45	End of the First Day of the Conference

Day 2, 25 September 2025 – Library of the Croatian Academy of Sciences and Arts, Trg Josipa Jurja Strossmayera 14, 10 000 Zagreb

9.00	Registration
9.15	Welcome Speech
9.30 – 10.15	**Digitization Standards and Challenges in Documenting Textiles in Armenian Manuscripts** Aldona Jędrusik (Austria)
	The Disinfection Efficiency of Gamma Irradiation Applied to Historical Objects Dragica Krstić, Branka Mihaljević (Croatia)
	Use of 3d Technologies for Restoration and Texturing of Archaeological Finds and Environments G. Jonaitis, R. Gudaitienė (Lithuania)
10.15	Discussion
10.30	Coffee Break
11.00 – 12.00	**Enhanced Preservation of Wooden Artefacts Using Atmospheric Pressure Plasma Jets** Nikša Krstulović (Croatia)
	The Importance of Material Analysis and Research on the Technique of Making Flocked Wallpapers from the 19th Century Before Restoration Treatment: The Case of Trakošćan Castle Valentina Meštić (Croatia)
	Potential and Efficacy of Brown Algae Extracts in the Prevention and Reduction of Deterioration of Archaeological Metal Finds Çağdaş Özdemir (Italy), Marina Brailo Šćepanović, Marta Kotlar, Lucia Emanuele (Croatia), Marcella Narracci, Laura Scrano (Italy)
	The Reconstruction of the Lost Seal of the Kingdom: An Example of Additive Manufacturing Application in Cultural Heritage Ladislav Dobrica, Roman Fraj-Sladoljev (Croatia)
12.00	Discussion
12.15 – 13.00	Lunch
13.00 – 14.00	Panel Discussion: **Artificial Intelligence & Cultural Heritage: Current Challenges and New Perspectives**
15.00 – 17.00	**Museum of Contemporary Art (Avenija Dubrovnik 17, Zagreb)** - Tour of the museum's permanent exhibition - Visit to the Conservation Department - Opening of the conference poster exhibition

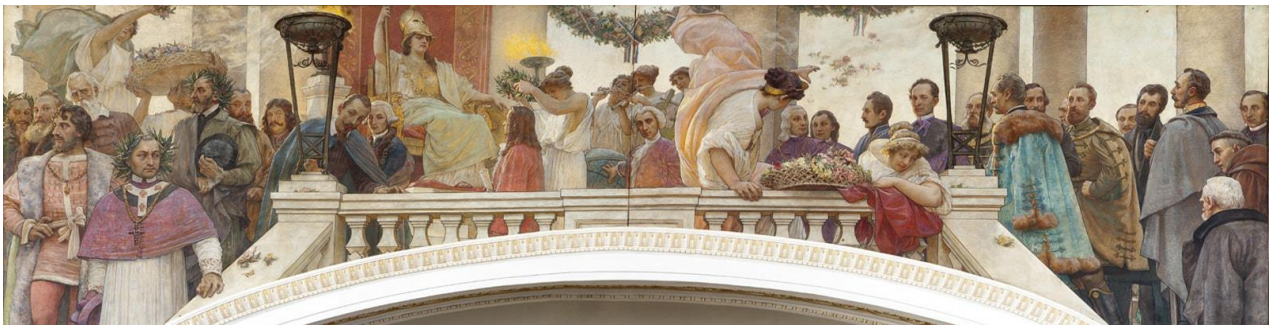
17.00 End of the Second Day of the Conference

Day 3, 26 September 2025 – University of Zagreb, Faculty of Graphic Arts, Getaldićeva 2, 10000 Zagreb

9.00	Registration
9.30	Welcome Speech
9.45	Guest Lecture: **Inclusive Heritage: Multisensory Experiences for Universal Accessibility** Prof.dr.sc. Raša Urbas (Slovenia)
10.15 – 11.15	**Sustainable Conservation of Organic Artworks in Museum Collections** Mirta Pavic, Jasna Jablan, Ivana Bacic (Croatia)
	Identification of the Painting Technique of Ancient Wall Paintings in Celje, Slovenia Katja Kavkler (Slovenia)
	Restoration of Damaged Materials from the Archives of Bosnia and Herzegovina After the 2014 Fire Edib Huseinagić (Bosnia and Herzegovina)
	The Study of the Green Color on the History Maps of the CSA Cartographic Collection Andreja Dragojević, Mirjana Jurić, Jelena Macan, Maja Strižić Jakovljević (Croatia)
11.15	Discussion
11.30	Opening of the Exhibition by students of the Faculty of Graphic Arts
12.00 – 12.30	Coffee Break
12.30 – 13.30	**Evaluation and Characterization of New Spirit Varnishes Based on Eutectic Systems** Cláudio C. Fernandes, Ana Quirino, Alexandre Paiva, Raquel Marques, Ana Rita C. Duarte (Portugal)
	Glagole Fonts – A Platform for Croatia's Fabulous Glagolitic Scripts Filip Cvitić (Croatia)
	Ion Accelerators in Cultural Heritage Preservation: A Review of Advanced Techniques and Application Medina Dugonjić (Bosnia and Herzegovina)
	Preservation of Heritage: Provenance and Restoration of Tapestries from the Zagreb Cathedral Treasury Tomica Plukavec, Emilia Plukavec (Croatia)
13.30 – 13.45	Discussion
13.45 – 14.45	Lunch

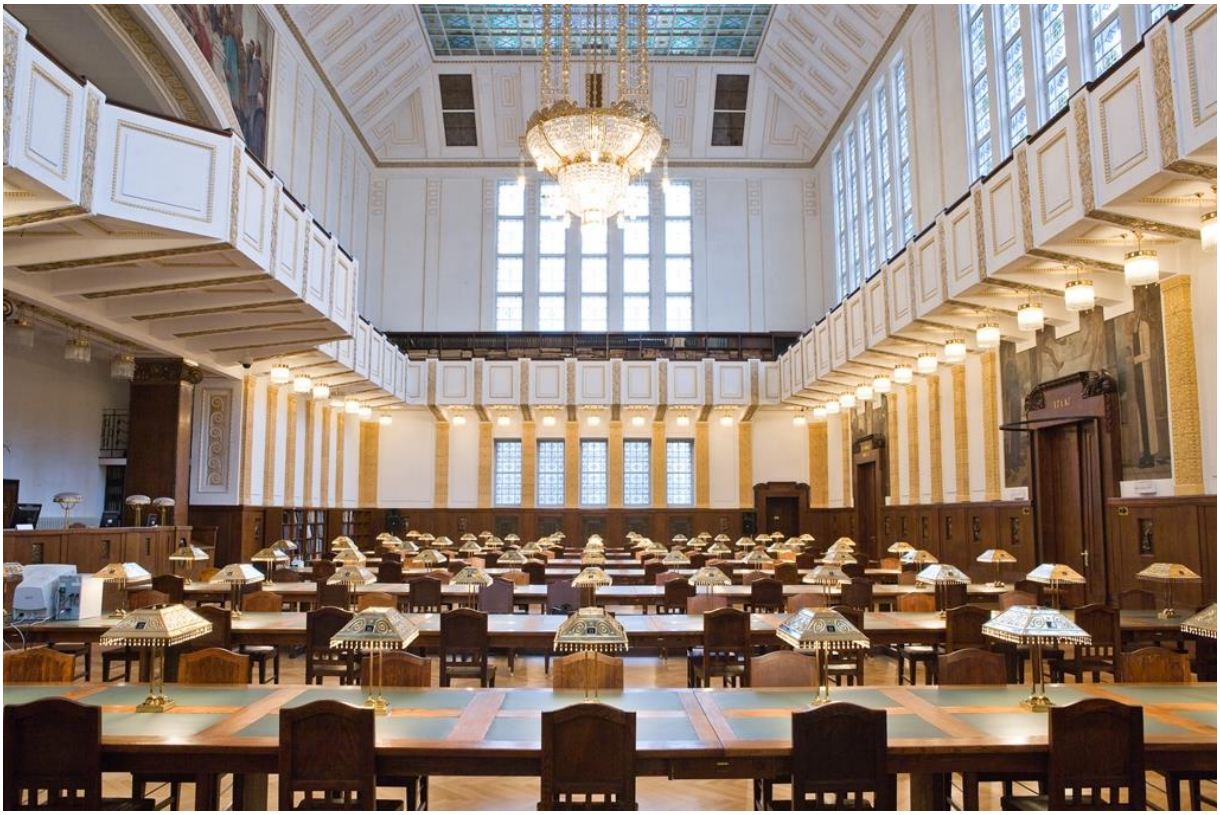
14.45 – 15.45	**The Use of Non-Destructive Techniques in Studying the Historical Monumental Heritage in Macedonia** Emel Sherif Miftar (Macedonia)
	Natural Pigments from the Shell of the Mali Ston Oyster and Their Application in Contemporary Printing Inks Marin Miletić, Maja Strižić Jakovljević (Croatia)
	Evaluating 3D Scanning Potential for Art and Heritage Digitalization Using Mobile Phone Cameras Alan Divjak, Vladimir Cviljušac, Damir Modrić (Croatia)
	The Senj Glagolitic Missal: Historical, Technological, and Cultural Insights Natali Selmanović, Maja Strižić Jakovljević (Croatia)
15.45	Discussion
16.00 – 17.00	Workshop: Multispectral Imaging in Art Conservation
	Tour of the Laboratory for Graphic Materials
17.00	End of the Conference

Abstracts



Vlaho Bukovac, *The Development of Croatian Culture*, 1913

Lectures



The reading room of the Croatian State Archives

Post-Conflict Heritage and the Role of International Organizations in Its Protection: Afghanistan as a Case Study

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Afghanistan, a country rich in cultural heritage, has witnessed profound losses in recent decades due to prolonged armed conflict, ideological extremism, and political instability. These devastating impacts have not only affected the nation's tangible heritage, such as monuments, archaeological sites, and artifacts, but have also threatened its intangible heritage, including traditions, languages, and knowledge systems. This destruction undermines Afghanistan's historical identity, creating a gap in the cultural memory and heritage of its people.

This paper examines the crucial role of international organizations, including UNESCO, ICOMOS, ICCROM, and ICESCO, in mitigating the widespread damage to Afghanistan's cultural heritage and supporting its restoration efforts. Focusing on Afghanistan as a case study, the research evaluates the effectiveness of these organizations' interventions, the challenges they encounter, and the outcomes of their programs in the post-conflict context. The study employs a mixed-methods approach, integrating archival research, interviews with experts in cultural preservation, and the analysis of secondary data, including satellite imagery and case studies of significant heritage sites.

In addition, the paper highlights the challenges of working in such a complex environment, where security risks, political instability, and limited resources hinder preservation efforts. It argues for more collaborative, long-term strategies that combine international expertise with local knowledge and capacity building. Ultimately, this study seeks to contribute to the growing body of research on post-conflict heritage preservation, emphasizing the need for enhanced global cooperation to protect Afghanistan's invaluable cultural legacy for future generations.

Keywords: cultural heritage, post-conflict preservation, UNESCO

Reimagining Digital Archaeology: Unveiling Power Dynamics Through Actor-Network Theory

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This paper will demonstrate the unbalanced power dynamic embedded in digital archaeology, specifically aerial digital archaeology. To maintain the power dynamic, the actor-network theory (ANT) will be used as a theoretical and methodological framework. The paper will primarily use qualitative desk-based research as well as documentary analysis of published archaeological data, institutional archives, and rules and regulations of the code of conduct to examine the black holes embedded in the process of knowledge progress for initial archaeology. It is argued that foreign control over data collection, interpretation, and dissemination shapes the outcome and narratives of the academic findings, rather than the local community.

The study will focus on Cambodia, and will draw on case studies such as the Cambodian Archaeological Lidar Initiative (CALI) and the published findings of Evans et al. (2013, 2016), which is a real-world example of how archaeology in Cambodia has progressed from traditional archaeology to the integration of advanced digital technologies. Having said that, while technology can be more scientifically productive and faster than traditional archaeology, such as foot surveys, it is also associated with broader structural challenges. The research above confirmed that technology such as LiDAR provides unprecedented access to the archaeological landscape, while also posing risks to cultural sovereignty when used without local engagement or transparency. The paper contends that Cambodian-led and co-led initiatives, as well as ethical frameworks for data stewardship, are critical to achieving equitable collaboration. Other issues include access to tools such as LiDAR, data interpretation and analysis, and control over data management, all of which remain largely in the hands of advanced institutions. Such structural imbalances may result in the marginalization of Cambodian scholars due to limited localization of expertise and a lack of access to data ownership. This will continue to have an impact on narrative, epistemic justice, and ethical co-production.

The study contends that hidden networks must be addressed through strengthened data ethics, and it suggests the need for clearer research codes of conduct to empower local actors in both knowledge creation and decision-making. By intruding and establishing a well-rounded code of conduct, archaeological networks can be reconfigured while also reducing structural imbalances. ANT enables researchers to better trace and address the socio-technical entanglements that shape knowledge, ethics, and power in the digital age.

Keywords: actor-network theory, ethics, aerial digital archaeology, parachute science, power dynamics

The Kwagh-Hir Cultural Heritage as a Tool for Intra-Ethnic Conflict Resolution Among the Tiv of Central Nigeria

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This study examines the influence of Kwagh-hir cultural heritage on intra-ethnic conflict resolution among the Tiv of Central Nigeria. The Tiv people are known for their rich cultural heritage, and one of the most prestigious cultural heritages in Tiv land is the Kwagh-hir (a traditional theatre), used for entertainment, enlightenment, and re-orientation of the people. This study used qualitative research methods such as in-depth interviews, participant observation, and archival research to examine how Kwagh-hir functions within Tiv communities as a means of resolving disputes. Results of the study show that the Kwagh-hir is a mechanism of conflict resolution among the Tiv. It enables community members to air their grievances, exchange ideas, and foster social cohesion. The Kwagh-hir uses performances to confront issues within the culture, such as land disputes, marital problems, and leadership challenges. By doing this, it opens up opportunities for conversation and healing. Moreover, the Kwagh-hir ensures the constant preservation and protection of Tiv culture, values, and belief systems, highlighting the paramount importance of community togetherness. Kwagh-hir is, therefore, a cultural mechanism for the promotion of peace, unity, and stability in Tiv society, as it brings together community members to interact, exchange ideas, sympathize, and appreciate one another. This becomes the essential core of safeguarding and promoting the Kwagh-hir as a traditional tool for conflict resolution and peacebuilding. The paper ends with a set of recommendations, employing heritage experts, custodians, and community leaders, among others, to utilize best practices in cultural heritage management for sustainable peace and development in Tiv society.

Keywords: cultural heritage, cultural performance, conflict resolution, Tiv society, Nigeria

Digitization of Stećci: An Interactive Approach to Medieval Funerary Iconography and Inscription

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Stećci are medieval tombstones found across the Balkan Dinaric region. Characterized by their diverse iconographic reliefs and typographic inscriptions in the Bosančica script, they offer valuable insight into the spiritual, artistic, and social practices of the time. However, ongoing exposure to the elements and to human activity have caused their decorative features to gradually erode, posing a serious threat to their preservation. Adding to the challenge, most relevant published literature on the culture of the stećci is available exclusively in limited-run print editions, restricting public accessibility. Digitization presents a practical solution by preserving vulnerable details, capturing features that may disappear within the next decade, while also creating a public repository for educational material about the subject.

This paper explores the application of widely available digital technologies for presenting, archiving, and educating about stećci, focusing on their typographic and iconographic elements. In terms of iconography, the paper examines frequently occurring motifs, their meanings, and possible origins, presenting semantic interpretations of these symbols. The linguistic and typographic components showcase a visual model of displaying epigraph characteristics, alongside a functional interactive transliterator that converts the Latin script to Bosančica, including support for ligatures and character variations.

Building on our previous research, the ultimate goal is to develop an inclusive web platform that provides essential information about the art of the stećci, granting researchers, art enthusiasts, and the general public access to detailed analyses of medieval funerary art, including its motifs, symbolism, language, and more. By integrating script transliteration features, 3D models, animation, and other visually impactful presentation methods, the platform aims to achieve high interactivity while allowing for easy engagement by all users. The website not only serves as an interactive introduction to the subject, but also a reference platform for existing literature, cultural institutions, and locally led preservation projects, providing further opportunities for community engagement.

Keywords: digitization, interactive education, cultural heritage, stećak, iconography

StećakLand: Material Heritage Presentation Through Virtual Reality and Theatre

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Stećci are UNESCO-protected medieval tombstones from Bosnia and Herzegovina, Serbia, Croatia, and Montenegro. Many of them are richly decorated with beautiful ornaments. The meanings of these ornaments are not well known, although they tell stories about the people who created them. The StećakLand project aims to introduce the general public to the symbolism of stećci through virtual and augmented reality and a theater play. We will present how each of these media implements the meanings of the ornaments found on stećci in museums, at necropolises, and in the theater.

Keywords: stećci, symbols from stećci, virtual reality in theater, virtual reality, augmented reality, digital heritage

"Walnut Shell Boats", in Greece (and Everywhere)

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This lecture will attempt to highlight the significance of traditional Greek toy-making practices as a vital element of both cultural heritage and childhood identity. Through a mixed-methods approach, drawing on tools from history, folklore, and anthropology, and utilizing interviews with adults (who hold bittersweet memories of self-made toys) as well as secondary sources such as the doctoral dissertation "Playing with the Toys of the Interwar Period: A Cosmopolitan Greekness," the study will document the ways, conditions, and reasons for the construction of makeshift toys in the past using natural or recycled materials such as wood, fabric, paper, pine cones, etc. Focusing on the Toy School that operated in Athens during the interwar period, and analyzing its curriculum, which combined handicraft techniques with modern pedagogical theories, the paper will present the types of handmade toys and their construction techniques with the following proposal: the compilation of a catalog that will include these traditional construction methods and the types of toys. This catalog/record/repository would be invaluable for reviving and preserving the cultural practice of toy-making and for connecting old traditions with modern learning if used in workshops such as lifelong learning centers, museum workshops, or kindergartens. There, participants, using easily accessible and cost-free materials and through experiential learning opportunities, would be involved in the preservation of this cultural practice and thus strengthen the appreciation of toy-making as an integral part of Greece's cultural identity – and not only Greece's, since similar practices were used to make toys everywhere in pre-industrial conditions or during times of war, exclusion, and deprivation.

Keywords: cultural heritage, preservation, toys, toy-making

Digital Voices from the Past: Integrating AI-Driven Speech and Avatar Synthesis for Cultural Heritage Interpretation

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This paper explores the innovative application of artificial intelligence (AI) technologies in creating digital twins to enhance the interpretation and presentation of cultural heritage. Focusing on the intersection of realistic digital avatar creation and advanced speech synthesis, we present a detailed case study on the development of a digital twin of writer Branko Ćopić. Using the MetaHuman Creator software, a photorealistic 3D model was produced, capturing Ćopić's distinct facial features and expressions. To authentically reproduce his vocal characteristics, AI-driven speech synthesis tools were employed, enabling the avatar to convincingly recite one of Ćopić's previously unpublished children's poems. The research examines both the creative process and technical challenges, with particular emphasis on facial animation realism and the natural flow of synthesized speech. By outlining the possibilities and limitations of these emerging technologies, the study offers valuable insights into their application within cultural heritage contexts. It also highlights how AI can support the preservation and creative dissemination of literary and historical figures, offering fresh educational experiences and encouraging broader public engagement with cultural assets.

Keywords: cultural heritage, AI-generated content, digital twin, speech synthesis

A 1725 Zagreb Pauline Antiphonary: Origins, Content, Structure, Materials, Chant Repertory

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In 2024, the National and University Library in Zagreb acquired a very precious codex named the Antiphonarium Romanum, copied by the Pauline friar Marcus Sylvestar in 1725.
This paper aims to present its content, history, neumatic notation, chant repertoire, and its most interesting material characteristics.
The codex's structure was studied, including the binding elements, paper watermarks, page layout, and the methods used to create it. The text and the neumes are written in ink on or around the inscribed staff. The title page contains a hand-painted frame of two columns with cartouches and vines around them. Throughout the manuscript, decorated initials in six different colors occur, in one color, or combinations of two or three colors. The text was written in at least two hands. The pigments, inks, and dyes were determined using nondestructive and noninvasive spectroscopic methods, X-ray fluorescence and Fourier-transform infrared spectroscopy.
Two types of decorative initials are used in this codex. The larger ones represent a modest version of littera arabescata. The smaller initials are sometimes decorated with a modestly elaborate graphic grid. It is notated in cursive Pauline chant notation (neumes) on a system of four red lines. This research will present the first analysis of the sanctorale of this manuscript and its melodic characteristics as well.
The results of the investigation show that the codex was executed as a planned whole. The same paper is used for the pages of the antiphonary and the pastedowns. Preparation preceded its execution, and an apt scribe skillfully used a conservative palette for illumination.

This presentation will provide the first comprehensive interdisciplinary review of the unknown musical manuscript of the Pauline monastery in Remete (Zagreb) and will show its importance in the context of the chant manuscripts of the Order of St. Paul the First Hermit in Croatia.

Keywords: Pauline antiphonary, illuminations, Pauline neumatic notation, chant repertoire

Advancing Modern Ink Analysis in Written and Printed Heritage: Application of MeV SIMS for Identification of Ink Colorants

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Understanding the composition of ink in written objects, as well as its stability under environmental conditions, is crucial for developing effective preservation strategies and mitigating ink degradation. Ink analysis is also essential for authenticating historical documents, helping to detect forgeries and verify the originality of manuscripts. Various non-invasive and micro-destructive techniques are employed to determine ink composition without harming delicate artefacts, such as Raman spectroscopy, X-ray fluorescence (XRF), and infrared spectroscopy. Chromatographic methods such as high-performance liquid chromatography (HPLC) or pyrolysis-gas chromatography-mass spectrometry (Py-GC/MS) provide detailed analyses of organic components, aiding in ink differentiation and the study of aging processes.

Secondary ion mass spectrometry with MeV primary ions (MeV SIMS) is a powerful nuclear analytical technique that has proven highly effective in identifying synthetic organic colorants (SOCs) in artists' paints and inks, overcoming some of the limitations of traditional methods. Its soft desorption and ionization process minimize fragmentation and surface damage, enabling the detection of molecular ions and the differentiation of complex pigment mixtures in micro-samples without the need for chemical separation. As a surface-sensitive technique, MeV SIMS is also well-suited to studying the aging and degradation processes in heritage objects

This work highlights the application of MeV SIMS in the analysis of written heritage objects, focusing on the identification and characterization of colorants used in 20th-century inks, as well as their stability and aging phenomena. A comprehensive analysis of real objects from the Museum of Contemporary Art in Zagreb, specifically screen-printed works by Boris Bućan from the 1970s, will be presented. By integrating MeV SIMS with simultaneous XRF and reflectance spectroscopy (RS) imaging, and dispersive Raman spectroscopy, this study also demonstrates the practical impact of a multi-analytical approach on the investigation and conservation of screenprints, which are a huge part of written heritage.

Keywords: MeV SIMS, modern ink, colorants, lightfastness

Serpents and Saints: Iconographic Codes and Visual Theology in Yılanlı Kilise, Cappadocia

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The Church of the Serpent (Yılanlı Kilise), part of the monastic complex in Göreme, Cappadocia, offers a visually and symbolically rich iconographic program that reflects the theological imagination of early Christian communities. The wall paintings, executed in a stylized Byzantine manner, present a striking narrative centered on serpents—represented both as demonic adversaries and as apotropaic elements within the sacred visual discourse. Saints such as George, Theodore, and Catherine are portrayed not only as heroic defenders of the faith, but as embodiments of divine order confronting spiritual chaos. This paper explores the visual theology embedded in these murals, highlighting how the iconographic language served didactic and protective functions in marginal ecclesiastical spaces. At the same time, the study addresses the challenges of preservation posed by the fragile volcanic tuff substrate and pigment deterioration. Non-invasive analytical methods such as multispectral and hyperspectral imaging are proposed to investigate both material composition and hidden layers of meaning. The paper advocates for a multidisciplinary approach that integrates iconographic interpretation, material analysis, and digital documentation to enhance the understanding and conservation of Cappadocia's mural heritage. Yılanlı Kilise emerges as a visual manuscript where theology, symbolism, and material fragility intertwine in a unique testament to sacred art.

Keywords: Byzantine mural painting, iconography, visual theology, Cappadocia, cultural heritage conservation

St Veronica, Volto Santo, and Anno Santo: Visual Testimonies of Pilgrimages

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As Cardinal Jacopo Stefaneschi reported in his *Liber de centesimo seu Iubileo anno*, at the beginning of the 14th century numerous pilgrims travelled to Rome, eager to obtain forgiveness for their sins and receive a plenary indulgence. Their journey was often arduous and perilous, yet they arrived with profound religious devotion. Boniface VIII, moved by their faith, sought to fulfil their expectations and, on 22 February 1300, issued the bull *Antiquorum habet fida relatio*, formally proclaiming the first Jubilee Year.

Since then, each Jubilee Year has drawn vast crowds of pilgrims to Rome, with one of the most venerated relics being the Volto Santo (Holy Face) in St Peter's Basilica. Croatian pilgrims have been recorded among them from the very beginning, as noted by Dante in the *Paradiso*:

"Like some pilgrim coming from as far
Away as Croatia, to see the holy image
Of our Lord's sweaty face" (XXXI, 103–105)

In Croatian Glagolitic missals, many depictions of Veronica and the Holy Face reflect an awareness not only of the relic itself but also of its placement in the (old) St Peter's Basilica—within a frame donated on the occasion of the first Jubilee Year—and in the structure (a ciborium) erected for its public veneration. This study examines how drawings, woodcuts, engravings, and related representations in sacred art, as well as early printed works, shaped the formation and reception of this iconography, particularly in Glagolitic illuminations and figural arts in Croatia from the Late Middle Ages to the early modern period.

Keywords: St Veronica, Holy Face, Jubilee Years, Glagolitic missals

The Beneventan Manuscript Heritage of Zagreb: Paleographic Perspectives on a History Between the Two Adriatic Shores

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The aim of this presentation is to provide an initial in-depth study of the manuscript heritage preserved in six institutions in Zagreb, namely the Archaeological Museum, the Croatian Academy of Sciences and Arts, the Croatian State Archives, the Archdioscesan Archives, the National and University Library, and the “Juraj Habdelic” Library. In particular, it seeks to highlight the central role that the study of Zagreb’s manuscripts plays within a PhD research project in Latin Paleography at the University of Bari “Aldo Moro” (funded by European grants) dedicated to the history of the so-called “Bari-type” Beneventan script. This research aims to define the areas of diffusion of this script by compiling a list of all the handwritten books and documents in which it appears and analyzing them, with the ultimate goal of gaining a deeper understanding of the script, and establishing its historical framework. The list, in its current state, consists of 260 manuscripts (considered as individual archival and library conservation units), which will be reassessed and expanded as the analysis of the manuscripts and archival research progresses. Approximately 80 of the manuscripts in this corpus are preserved in Croatia, of which about 25 are in Zagreb.
Therefore, this presentation will provide an overview of the manuscripts preserved in Zagreb—including codices (sometimes fragmentary or palimpsestic) as well as documents—offering a bibliological and paleographical analysis of these materials and presenting some initial general reflections.
The ultimate goal is to emphasize the need to enhance the value of Zagreb’s manuscript heritage, the institutions that preserve it, and the histories it conveys.
This proposal arose in the light of a period of study and work at Croatian institutions dedicated to the preservation of these manuscripts, particularly in Zagreb.

Keywords: research on written cultural heritage; Beneventan script; enhancement of manuscript heritage

Ptolemy and Regiomontanus: Astronomical Works in the Corvinian Library

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This text discusses the keen interest in astrology of King Matthias I of Hungary (reigned 1458–1490 as King of Hungary and Croatia), who hosted renowned astronomers like Johannes Regiomontanus at his court. The lecture will present four astronomical manuscripts (including corvinas) associated with Matthias's Corvina Library: 1. *Magna compositio* by Ptolemy (Vienna, ÖNB, Cod. 24); 2. *Epitome Almagesti* by Peuerbach and Regiomontanus (Vienna, ÖNB, Cod. 44); 3. *Tabula primi mobilis* by Regiomontanus (Budapest, NSZL, Cod. Lat. 412.); 4. *Tabulae directionum* by Regiomontanus (Wolfenbüttel, HAB, Cod. Guelf. 69.9 Aug. 2°).
These codices span from ancient (Ptolemy) to medieval (Peuerbach and his pupil Regiomontanus) astronomy. The lecture will explore their content, the relationships between the authors, and the reasons for their inclusion in the royal library. It will also highlight the manuscripts' illuminations and the illustrators involved in the decoration of the codices, shedding light on the development of the Corvina Library and the patronage of Johannes de Zredna, King Matthias, and Queen Beatrix.

Keywords: astronomy, illuminated codices, Ptolemy, Johannes Regiomontanus, Corvinian Library, Matthias I, King of Hungary and Croatia

First edition of the novel *Planine* by Petar Zoranić, Library of the Croatian Academy of Sciences and Arts

Digitization Standards and Challenges in Documenting Textiles in Armenian Manuscripts

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Presented here are initial findings from a systematic survey of digitized images of Armenian manuscripts and printed books, focusing on the textiles used in binding structures. Over 300 digital resources from major collections were analyzed, assessing how textiles—used as pastedowns, covers, and structural elements—are documented and depicted. The study revealed considerable inconsistencies in image resolution, metadata quality, and the visibility of textile elements. Approximately 40% of surveyed images allowed partial description of textile motifs (floral, figural, abstract), while only 20% permitted detailed analysis of weave patterns or dye characteristics. A significant number of internal textiles remain undocumented in catalogues, limiting their accessibility for scholarly and conservation work.

Despite these challenges, high-quality images from collections in Berlin, Paris, and Warsaw enabled the identification of textile types and potential production regions, contributing to a growing knowledge base. This work, part of a larger conservation-focused project, advocates for improved digitization protocols specific to textiles in books. Recommendations include standardized image resolution guidelines, the inclusion of marginal textile details, and enhanced metadata fields for textile description.

By bridging digital humanities, codicology, and conservation science, this study underscores the role of digitization not only as a preservation tool but also as a medium for uncovering cultural heritage that has previously been obscured. The study's outcomes aim to support better documentation, comparative analysis, and preservation of Armenian book textiles, offering a model for similar efforts in other manuscript traditions.

Keywords: Armenian manuscripts, textiles, digitization, metadata

The Disinfection Efficiency of Gamma Irradiation Applied to Historical Objects

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This study aims to assess the efficiency of gamma radiation in disinfecting cultural heritage objects or historical materials such as paper and leather in a library setting. Materials attacked by microorganisms that developed in unfavorable, humid conditions (due to water leaks, floods, or moisture penetration) were subjected to disinfection treatment using ionizing radiation at a panoramic gamma radiation facility at the Ruđer Bošković Institute.
In addition to the radiation treatment on the large quantity of infected books, it was decided to verify the effectiveness of the biocidal effect of gamma radiation in collaboration with Italian experts at the chosen dose applied to two infected books from the National and University Library in Zagreb, and to determine the minimum radiation dose that could be used. The reason why these books were chosen was the microbial growth on the different types of paper, leather, and binding from which the books were made.
Before irradiation, microbiological sampling was performed on the selected books to investigate the types of microorganisms present on the samples. From each sample, a predominant growth of a fungal strain was observed, indicating that the fungal colonization on the book materials was predominant.
The microbiological analysis of the books after irradiation showed that the 3.74 kGy dose was effective on a large part of the fungi that grew before the gamma ray treatment; four fungal strains and three bacterial strains were still alive. The 7.75 kGy dose was more effective: only one fungal and one bacterial strain developed.
The investigation of the effect of the irradiation parameters on the radioresistance of the microorganisms responsible for the biodeterioration of the books showed that if the high dose rate is used (1.5 kGy/h), the absorbed dose of 7.75 kGy is sufficient for full eradication in both books.
Based on the results obtained, it is concluded that the inactivation of microorganisms was effective under the irradiation conditions applied. This research is an example of the application of a unique and rapid method of disinfection of library materials using ionizing radiation. It is also an example of how close collaboration between conservators-restorers and radiation technologists and researchers is crucial for the successful disinfection of historical or cultural heritage objects.

Keywords: library materials, biodeterioration, disinfection, gamma irradiation, radioresistance gamma irradiation, radioresistance

Use of 3d Technologies for Restoration and Texturing of Archaeological Finds and Environments

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The rapid development of three-dimensional graphics tools and rendering engines has made texturing and lighting essential for creating photorealistic digital environments. Such technologies are applied not only in product visualization and animation but also in the preservation of cultural heritage, where 3D scanning and reconstruction ensure accessibility and long-term safeguarding. A 3D object can be described by its surface and volumetric properties, while reconstruction techniques typically rely on linking two-dimensional imagery to spatial geometry. Realism is further enhanced through accurate texturing methods, either procedural or image-based, and depends on visualization creation software. The main goal of this research was to investigate the change in the qualitative parameters of texture synthesis and image visualization of three-dimensional historical objects in the context of different visualization systems.

This study investigates the variation of texturing and visualization quality across different rendering engines, including Cycles, V-Ray, and Corona, highlighting differences in speed, noise levels, and colorimetric fidelity. At the same time, it emphasizes the cultural value of such methods. The 3D scanning of the beer cellar movie set at Cinevilla (Figure 1) demonstrates how digital documentation supports restoration efforts and preserves historical heritage. Beyond technical replication, these models serve as digital archives, enable remote exploration, and provide material for educational and touristic applications. In this way, photorealistic 3D visualizations contribute both to technological advancement and to the safeguarding of cultural memory. Acknowledgment: We thank the Lithuanian Academic Council for their financial support.

Keywords: 3D modelling, visualization, texture synthesis, rendering engines, cultural heritage, restoration.

Enhanced Preservation of Wooden Artefacts Using Atmospheric Pressure Plasma Jets

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This study explores the application of a non-thermal atmospheric pressure plasma jet for disinfecting wooden artifacts. Test plates were deliberately contaminated with the fungal mycelium *Coniophora puteana* and treated with an atmospheric pressure plasma jet using argon gas. Over a seven-day post-treatment period, the growth of the mycelium on the plates' surfaces was observed by measuring the area covered. The findings revealed that mycelia respond to the stress induced by plasma treatment by excreting Ca-oxalate crystals, which halt further growth. Importantly, the plasma process does not alter the composition of gilded or lacquered surfaces on the test plates, making it suitable for removing atmospheric contaminants. The cold atmospheric pressure plasma jet of argon demonstrates high efficiency in eliminating fungi from wooden artifacts. Additionally, this technique lays promising groundwork for further enhancements, such as integrating antimicrobial ZnO nanoparticles into paper, textile, or painted surfaces to offer advanced protection of artefacts.

Keywords: cold atmospheric plasma, plasma sterilization, disinfection of wooden artefacts

The reading room of the Library of the Croatian Academy of Sciences and Arts

The Importance of Material Analysis and Research on the Technique of Making Flocked Wallpapers from the 19th Century Before Restoration Treatment: The Case of Trakošćan Castle

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The study of historical interiors requires a multidisciplinary approach, especially for delicate decorative elements like flocked wallpapers. Often used in the 19th century to embellish aristocratic residences, these wallpapers present unique conservation challenges. This research highlights the importance of material analysis and technical investigation before restoration, using Trakošćan Castle as a case study.

Trakošćan Castle, a cultural monument of national importance in Croatia, preserves an interior reflecting 19th-century aristocratic tastes. Among its decorative elements, flocked wallpapers stand out for their intricate production techniques, material composition, and aesthetic appeal. However, environmental factors, inappropriate interventions in the past, and natural aging have caused significant deterioration. Proper conservation requires a thorough understanding of their materials, production methods, and degradation mechanisms.

This study employs analytical techniques such as SEM-ED, FTIR, and XRF to identify pigments, adhesives, and metallic components. By determining the wallpapers' composition and causes of deterioration, the aim is to establish a scientifically informed conservation strategy aligned with best heritage preservation practices.

Historical research into manufacturing techniques and comparative studies of 19th-century flocked wallpapers further inform the analysis. Additionally, the research explores the socio-cultural context of Trakošćan Castle, examining how these wallpapers contributed to the symbolic representation of aristocratic status.

The findings emphasize the necessity of pre-restoration material analysis as a critical conservation step. Understanding original materials guides restoration decisions and prevents irreversible damage from unsuitable interventions. Moreover, knowledge of materials is vital for health and safety, ensuring restoration does not expose conservators or tourists to hazardous substances like toxic pigments, adhesives, or degraded materials. Prioritizing safety in conservation protects both heritage and those involved in its preservation.

Ultimately, this study underscores the importance of an interdisciplinary approach integrating scientific research with conservation practice. The case of Trakošćan Castle serves as a model for similar restoration projects, highlighting the role of collaboration in safeguarding cultural heritage.

Keywords: Trakošćan Castle, 19th-century interiors, historical wallpapers, material analysis, conservation science

Potential and Efficacy of Brown Algae Extracts in the Prevention and Reduction of Deterioration of Archaeological Metal Finds

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The biocorrosion of metal materials found in archaeological excavations prevents us from knowing the history of our cultural heritage and transmitting it, together with the finds, to future generations. Reducing and/or eliminating bacterial biofilm on metal surfaces, which is responsible for corrosion, using extracts of plant species, is a way forward. In this research, extracts of *Padina pavonica L.* and *Dictyota acutiloba* brown algae, both belonging to the family Dictyotaceae, species present in the Mediterranean Sea, have been used. The target chosen for in vitro tests was *Pseudomonas aeruginosa*, a Gram-, aerobic/anaerobic facultative bacterium known to form resistant biofilms on different surfaces. The algae, collected in the summer season near the Dubrovnik coast, were subjected to extraction and chemical characterization. Both minimum inhibitory concentration (MIC) and time-kill tests were performed to determine their antimicrobial activity. Two tests were performed using copper samples before the treatment on archaeological finds. In Test 1, the surface of the samples was previously treated with the extracts and then contaminated with the bacterium (preventive action). In Test 2, the metal surface was contaminated with the bacterium and the extracts were applied to the biofilm (curative action). In both cases, the outcome was positive: the extracts strongly inhibited the development of the bacterial colony (Test 1) and also strongly deteriorated the biofilm (Test 2). It should be noted, however, that the effectiveness of *Padina pavonica L.* extract was four times greater than the *Dictyota acutiloba* extract. These results encourage us to continue our research and confirm the great effectiveness of natural products and the great potential of both terrestrial and aquatic plant species.

Keywords: copper materials, cultural heritage, green conservation, *Dictyota acutiloba* and *Padina pavonica L.* extracts

The Reconstruction of the Lost Seal of the Kingdom: An Example of Additive Manufacturing Application in Cultural Heritage

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The seal granted to the Kingdom of Slavonia by King Vladislaus II Jagiellon in 1496 became for the following four centuries the seal of the Parliament of the Kingdoms of Dalmatia, Croatia, and Slavonia (the *Sabor*). The first seal, which was in use until the mid-18th century, was replaced due to wear with a new one. The new seal differed from the old one in a single detail: a lily on the central horn of the shield was added. Unfortunately, the seal was misplaced during the Second World War and since then it has been considered lost.

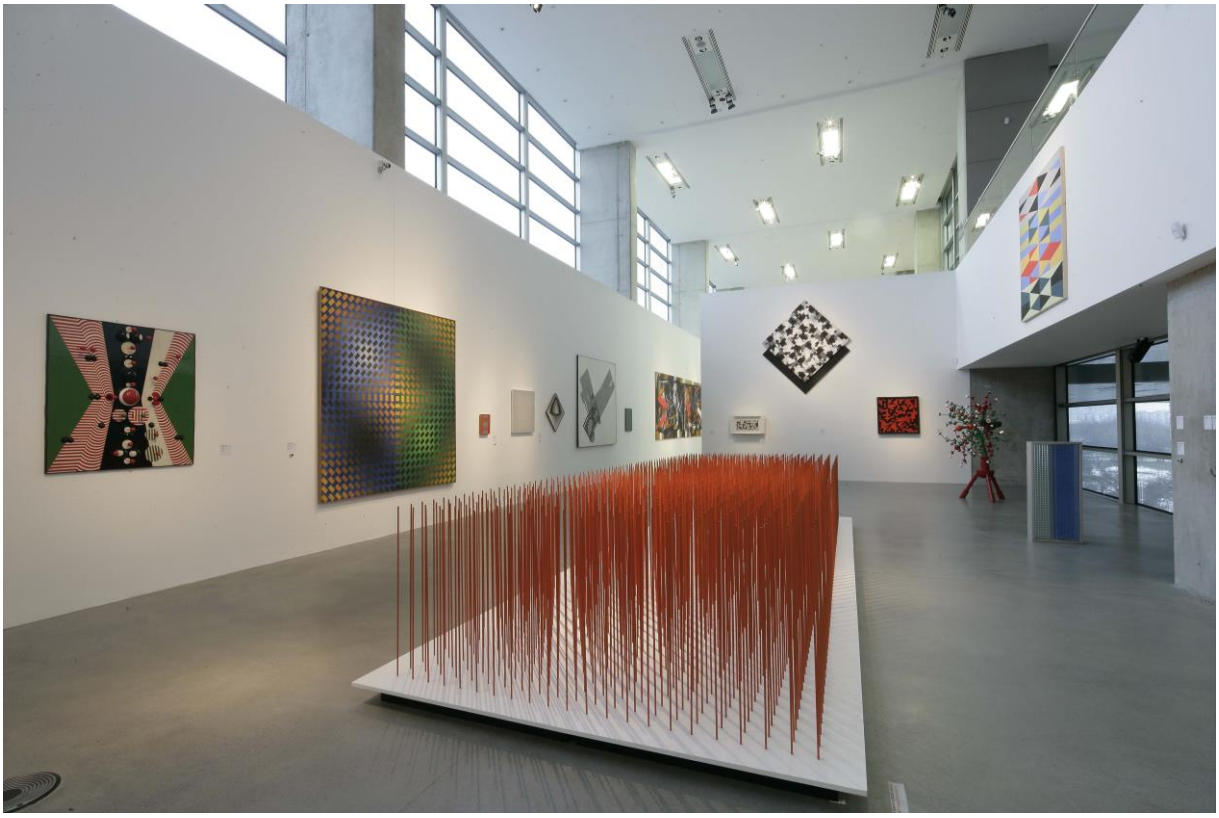
Since dozens of seal impressions under paper have been preserved in the pages of parliamentary records, additive manufacturing was applied in order to make a reconstruction of this lost artefact of national importance.

To reconstruct the lost seal, 3D scanning technology was used to capture several well-preserved impressions. The scanned data were then processed and converted into a 3D model using specialized software. In order to accurately reconstruct the shape and size of the seal, a preserved seal from the same time period and region served as a reference. Using CAD software and the processed 3D data, a digital model of the seal was created. Finally, 3D printing was employed to produce a physical reconstruction of the seal.

The presentation will consist of two sections. The first will cover the history and usage of the seal, while the other will explain the reconstruction process that utilized the aforementioned technologies.

This project aims to stand as an example of a good practice of applying this technology in preserving cultural heritage at an archival institution.

Keywords: Croatian parliament (*Sabor*), sigillography, cultural heritage, additive manufacturing, 3D scanning



Permanent exhibition of the Museum of Contemporary Art

The Museum of Contemporary Art, Atelier Kožarić


grafički
FAKULTET

Inclusive Heritage:Multisensory Experiences for Universal Accessibility

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Public institutions—museums, galleries, archives, libraries, heritage sites, and interpretation centres—play an essential role in how cultural heritage is experienced, preserved, interpreted, and communicated. If these institutions are to serve all members of society, they must actively cater to the diverse needs of their audiences, especially those who have (perhaps) been excluded in the past. For blind and visually impaired visitors, access is not just about entering a space, but also about being able to experience and interpret its contents in a meaningful way.

The museum path *Touch It!* is the first fully adapted museum experience in Slovenia for visitors with visual impairments. It creates a multisensory environment where information is accessible through touch, sound, spatial navigation, and carefully customised visual content. Tactile maps, Braille labels, large print texts, and object replicas have been developed with different materials and techniques to enrich the visitor's experience. To ensure usability and relevance, the project was developed in close collaboration with blind and visually impaired individuals as well as sighted individuals at every stage of the process.

Although the project was primarily designed for blind and visually impaired visitors, its impact went far beyond this group. It showed how inclusive design can improve the museum experience for all. Many sighted participants reported that the tactile and acoustic elements not only clarified the content but also deepened their emotional connection to the exhibition.

Multisensory design plays a key role in inclusive communication. By integrating touch, sound, smell and even taste into graphic and spatial experiences, designers open up new pathways for perception and interpretation. This approach challenges the dominance of visual communication and enables a broader, more empathetic engagement with cultural content. It invites us to design not just for the eye, but for the whole body—encouraging cognitive, emotional, and physical connections.

Keywords: inclusive design, multisensory interpretation, museum accessibility

Sustainable Conservation of Organic Artworks in Museum Collections

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Nailed Bread (1973), a conceptual artwork by Dragoljub Raša Todosijević, is made of organic material: bread in combination with wood and metal. It belongs to the collection of the Museum of Contemporary Art in Zagreb. In 2010, after almost 40 years, its structure started to show signs of disintegration, and it was necessary to find an optimal conservation methodology in order to preserve the object. The bread was consolidated by injecting a 6% solution of Paraloid B-72 in ethyl alcohol and subjected to gamma irradiation. Eight years later, changes were again detected, and a new study was carried out. Four different consolidants were applied to test samples to select the one with the best properties for conserving bread (Paraloid B-72, Aquazol 200, Aquazol 500, and Mowilith 50). Each consolidant, prepared in a 6% solution, was applied using the injection method. The analysis showed that all four consolidants were effective, but their distribution in the material was inconsistent. This result was confirmed by the RISE analysis method, which was developed in collaboration with the Institute for Electron Microscopy and Nanoanalytics (FELMI) at Graz University of Technology.

In the next phase of research, accelerated aging tests were carried out to evaluate the stability of the samples under different humidity, temperature, and light conditions and to determine the most effective application method. Three different techniques were tested: injection, immersion for different periods of time (15 minutes, 30 minutes, 1 hour, and 24 hours), and application in a vacuum system.

Each method was evaluated based on its effects on the appearance of the material, resistance to microclimatic changes, and uniformity of consolidant distribution.

To analyze the distribution of the consolidant in the samples, FTIR spectroscopy using the diamond ATR single reflection technique was performed on 13 different locations of the test samples. The results showed that Aquazol 200, which was immersed in the organic material for 15 minutes, had the best retention capacity and the most even distribution in the organic material, making it the best choice for preserving the artworks.

Keywords: organic material, bread, contemporary art, consolidation, RISE, ATR-FTIR

Identification of the Painting Technique of Ancient Wall Paintings in Celje, Slovenia

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In 2016, excavations in ancient Celeia (modern-day Celje, Slovenia) revealed the remains of a villa from the 1st century. Almost 5,000 fragments of a ceiling painting were found in one of the rooms. The assembled scenes measure approximately 14m². Additionally, the remains of a wall were discovered in situ in the same room. The remains of the walls were approximately half a meter in height. These walls were also painted.
Microscopic and spectroscopic analyses were performed on samples extracted from both in situ remaining walls and ceiling fragments to identify the painting technique. The paintings were characterized by a very smooth and shiny background and a pasty matte figural and ornamental application of paints. The background paint seemed to penetrate into the surface plaster layer, whereas the pasty applications were clearly painted on a dry surface. Therefore, we assumed that at least part of the painting was done using secco techniques. Samples were extracted from paint layers to identify the binder, however without success.
It was not until the first cleaning tests were performed on the remaining in situ walls that the binder could finally be identified. The cleaning tests were performed using various organic solvents and Wolbers' solutions, as well as with cotton swabs. In the laboratory, the materials were re-extracted from the cotton swabs with the cleaning agent used for each cleaning test respectively. Infrared spectroscopy (FTIR) analyses were performed on re-extracts from the cotton swabs. Wax and fatty acids were identified. Further FTIR analyses confirmed the presence of wax and/or fatty acids on paint samples from various parts of the wall and ceiling paintings, both on the background and pasty paint layers.
A further series of analyses were carried out on ceiling fragments, using minimal sampling (1mg) for GC-MS analyses, where individual fatty acids and other long-chain organic components, characteristic of waxes, were identified. These observations are consistent with the results of the FTIR analyses. Additionally, the comparison with model samples containing a wax emulsion showed similar results in the identification of the peaks. In addition, the ratios of palmitic acid/stearic acid (P/S) and azelaic acid/palmitic acid (A/P) were also determined (P/S from 2.3 to 4.5 and A/P from 0.08 to 2.0), confirming the presence of mixtures. This was the first confirmed ancient encaustic wall painting discovered on the territory of present-day Slovenia.

Keywords: ancient wall paintings, encaustics, FTIR, GC-MS

Restoration of Damaged Materials from the Archives of Bosnia and Herzegovina After the 2014 Fire

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In February 2014, Bosnia and Herzegovina was gripped by mass protests caused by deep social and political dissatisfaction. During the escalation of violence in Sarajevo, several public buildings were set on fire, including the building of the Presidency of Bosnia and Herzegovina, which houses the headquarters of the Archives of Bosnia and Herzegovina, as well as one of the largest depots of the Archives of Bosnia and Herzegovina, Depot Number 1, which comprises three rooms. Documents from the period of the Austro-Hungarian administration, the Kingdom of Yugoslavia, the Independent State of Croatia, socialist Yugoslavia, as well as numerous documents from the period after the independence of Bosnia and Hercegovina were destroyed or burned. It is estimated that more than 60 holdings and collections were damaged, and the oldest and most sensitive materials suffered the most damage. Experts from the Archives of Bosnia and Herzegovina, in cooperation with domestic and international partners, organized the urgent collection, stabilization, and preventive protection of the materials.

After the initial rescue measures, a long-term restoration process followed, which continues to this day. The restoration procedures are based on international standards for the protection of paper, and include several key phases.

A particularly challenging part of the process is the consolidation of weakened paper fibers. In the case of documents that suffered extensive fire damage, the paper infiltration method is applied with a thin layer of Japanese paper or by pouring paper pulp, with the use of special glues based on starch or methylcellulose. These methods enable the stabilization of fragile parts and prevent their further disintegration.

The 2014 disaster showed how vulnerable archives are in crisis situations and how important it is to continuously invest in prevention, fire protection systems, staff training and safety protocols, as well as in developing collective awareness of the importance of written cultural heritage.

It is important to note that the damaged archival materials from the aforementioned depot survived three wars, were transferred to Vienna twice and returned, but were preserved until 2014.

Despite all the difficulties, the work to save archival materials from the Sarajevo fire became an example of perseverance, expertise, and international solidarity in the protection of cultural heritage.

Keywords: restoration, conservation, cultural heritage

The Study of the Green Color on the History Maps of the CSA Cartographic Collection

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The Cartographic Collection of the Croatian State Archives preserves copper-cut hand-colored maps from the 16th-18th centuries, manuscript cadastral plans from the period of the cadastre of Joseph II (1785-1790), and plans of settlements with fortifications that were created immediately before the period of the cadastre of Joseph II. The Archive of Maps for Croatia and Slavonia, meanwhile, preserves manuscript cadastral plans from the period of the cadastre of Francis I (1847-1877). All these plans were created through fieldwork, hand-colored at the time of the survey, and in our research, we will concentrate exclusively on the green color that was used on the plans to depict pastures, meadows, and gardens, and also, unusually, to depict watercourses. On the maps, green was used to depict borders, vegetation, and to color parts of the territorial-administrative organization of a certain area. All the maps and plans depict Croatian territories in a historical context.

This multidisciplinary research combines microscopic analysis, chemical characterization, and optical quantification, enabling a detailed understanding of how the green color layer binds to the paper, as well as its chemical composition. A visual method using a digital microscope with 500x magnification allowed the observation of the different ways in which the color layer bonded to the paper. This included: the layer that remained on the surface of the paper; the layer that partially penetrated the paper structure; the color layer that fully dyed the paper fibers; and the color that penetrated the paper and was visible on the reverse side.

FTIR and SEM methods were used to investigate the composition of the green color. FTIR helped identify the chemical compounds in the pigment. SEM provided a more detailed insight into the structure of the pigment and its interaction with the paper. Meanwhile, spectrophotometry was used for numerical evaluation of the green color, allowing for an objective comparison of the different shades and characteristics of green on the samples.

The aim of this research is to analyze the application of the color green in geographic maps from the 16th to the 19th century, with an emphasis on identifying and comparing its colorimetric, physical, and chemical properties. The study will focus on the development and changes in the use of green over the centuries, as well as the impact of these characteristics on the perception, aesthetics, and technical execution of cartographic representations.

This approach provides a comprehensive overview of the evolution of green in cartography while highlighting specific aspects of its composition and application.

Keywords: green color, history maps, optical, physical, and chemical properties, Cartographic Collection

The University of Zagreb, Faculty of Graphic Arts

The University of Zagreb, Faculty of Graphic Arts, Laboratory for Graphic Materials

Evaluation and Characterization of New Spirit Varnishes Based on Eutectic Systems

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One of the main challenges conservators and restorers continue to face is the reliance on solvents that are toxic, flammable, hazardous, and potentially carcinogenic, but that are commonly used in the removal of aged varnishes and in varnish formulations (e.g., spirit varnishes). This study aimed to investigate the potential of natural deep eutectic systems (NADES) as greener alternatives in varnish formulations. These solvents consist of mixing two or more natural, non-toxic components, which at a specific molar ratio and at room temperature result in a liquid system, due to a large depression in the melting point of the mixture. The main goal was to explore their efficiency in replacing some toxic solvents typically used in varnish formulation. Starting with the physicochemical characterization of traditional solvents (turpentine and white spirit) and natural resins (dammar and mastic), via solvatochromic parameters and FTIR spectroscopy, it was possible to screen and select the NADES with the most suitable characteristics. The spirit varnishes were then prepared using the traditional method and the formulations were characterized in terms of refractive index, viscosity, rheology, contact angle, surface tension, etc. Additionally, the coating films that formed were also analyzed in terms of their aspect, composition after solvent evaporation, and surface roughness, using techniques such as FTIR spectroscopy and atomic force microscopy (AFM). The results demonstrated comparable performance between the eutectic system-based varnishes and those prepared with traditional solvents in terms of visual appearance, flow behavior, and surface interaction.

Keywords: natural deep eutectic systems, green solvent, varnish, turpentine, conservation-restoration, cultural heritage

Glagole Fonts – A Platform for Croatia's Fabulous Glagolitic Scripts

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Traditional promotion of cultural heritage is limited by national borders, but digital tools enable its global expansion, making it accessible to a broader audience regardless of identity or location.

To engage people outside its homeland, cultural heritage must be more accessible. This involves redefining its values so that its content becomes clearer and universally relatable, making it available to people from different parts of the world.

Glagole is a digital platform dedicated to preserving and promoting the Glagolitic script through a design-driven approach. The goal is to present Glagolitic fonts in an innovative way, incorporating elements of science fiction to make the script appear attractive and universal. Glagolitic is thus portrayed as an extraterrestrial script, a writing system from other worlds and dimensions. This approach conveys a specific message: on the platform the Glagolitic script is used to depict magic, ancient times, fantasy worlds, chivalry, and futuristic civilizations more advanced than our own. All of this is done with the aim of making the Glagolitic script fun, interesting, entertaining, and appealing to people who have never encountered it before.

The platform features a range of key elements that combine education, commerce, and user behavior analytics. At the core of the Glagole platform is the display of digital Glagolitic fonts, presented in a visually engaging manner. An educational-commercial model will connect informative articles about the Glagolitic script with the option to purchase typographic products, while user interest analytics will track visitor behavior to continuously refine promotion strategies. The visual product store will offer Glagolitic script posters and related typographic items, while the concept of design democratization will allow creators to independently upload and promote their own work to the platform. Finally, an innovative design language inspired by science fiction will serve to introduce the Glagolitic script to the entertainment industry and popular culture, bringing this historical script closer to a younger audience.

Glagole represents an innovative approach to preserving and popularizing cultural heritage through contemporary design and digital technologies. Through educational content, market opportunities, and a modern approach to typography, the platform offers a unique experience that showcases the written part of cultural heritage on modern platforms using cutting-edge technology.

Keywords: Glagolitic script, cultural heritage, digital platform, design, typography

Ion Accelerators in Cultural Heritage Preservation: A Review of Advanced Techniques and Application

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Ion accelerators, primarily used for research in physics, but also in engineering and medicine, have valuable applications in cultural heritage preservation. These technologies assist archaeologists, historians, and conservators in analyzing and protecting historical artifacts. This review focuses on the theoretical description of ion accelerator techniques in dating, material characterization, and non-destructive analysis of artifacts. Key applications include accelerator mass spectrometry (AMS) for radiocarbon dating, ion beam analysis (IBA) such as particle induced X-ray emission (PIXE) for elemental composition identification, and proton induced gamma-ray emission (PIGE) for precise chemical characterization. Another IBA technique, micro-PIXE (μPIXE), enables high-resolution spatial mapping of elements in cultural artifacts such as artworks, manuscripts, and archaeological objects. These methods offer high precision, minimal invasiveness, and applicability to diverse materials, including manuscripts, paintings, ceramics, and metals. Research and artifact characterization that have already been done in this way demonstrate the intersection of the natural sciences, especially physics, and the humanities, particularly in archaeology, art restoration, and historical research, by providing precise, non-invasive analytical methods. The interdisciplinary collaboration between physicists, chemists, historians, and conservationists underscores the essential role of science in preserving cultural identity.

Keywords: ion accelerators, accelerator mass spectrometry (AMS), ion beam analysis (IBA), non-invasive methods, cultural heritage

Preservation of Heritage: Provenance and Restoration of Tapestries from the Zagreb Cathedral Treasury

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The Treasury of the Zagreb Cathedral preserves an exceptionally valuable collection of historical sacral vestments and works of art, among which a special place is occupied by five tapestries from the *Months of the Year* cycle. They represent masterpieces of artistic craftsmanship and testify to the high craftsmanship of the weavers of the court workshop of the Duke of Lorraine, led by Charles Mité. Each of the tapestries thematically depicts two months of the year, and their scenes are placed within richly decorated illusionistic frames, and in the compositional center there are imaginative architectural elements of complex perspective elaboration. They were inspired by the architectural perspectives of the Bolognese artist Francesco Gallio Bibiena (1659-1739) and were woven in the early 18th century for the court of the Dukes of Lorraine. In the mid-18th century, they arrived at the court of Vienna as part of a wedding gift on the occasion of the marriage of Francis III of Lorraine and Empress Maria Theresa. It is assumed that later, during the reign of Bishop Francis Thausszy (1751-1769), they arrived at the Zagreb episcopal court as a gift from the Empress herself. Their history as part of Croatian heritage became official in 1856, when Ivan Kukuljević entered them into the cathedral inventory. This study examines the tapestries' journey to the Treasury of Zagreb Cathedral, as well as their restoration, which began in 2015 and continues to this day. Careful conservation and restoration procedures are of paramount importance in order to preserve the artistic and historical value of the sumptuous and superbly crafted tapestries for future generations.

Keywords: tapestries, Zagreb Cathedral, Treasury, cultural heritage

The Use of Non-Destructive Techniques in Studying the Historical Monumental Heritage in Macedonia

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The National Institution – National Center for Conservation – Skopje, has registered 24,350 icons, 4,200 archaeological sites, 1,760 churches and monasteries, 1,200 ancient architectural objects, and over 400 other objects and sites from various types and periods. More than 1,300 places have been valorized as having cultural-historical significance of great value and in more than 200 immovable cultural monuments conservation and restoration activities have been carried out. Our main focus will be introducing and using non-destructive techniques including XRD, Raman, and IR Spectroscopy for analysis and chemical identification of surface materials from cultural and historical monumental heritage in Macedonia. These techniques are of great importance for the preservation and conservation of both movable and immovable monuments of great value. In the paper as a representative study of these techniques the results of the samples analyzed will be presented and further discussed for a diagnosis of the current state as well as preservation and conservation activities for monumental heritage in Macedonia.

Keywords: non-destructive techniques, cultural heritage, monuments, building material, preservation and conservation

Natural Pigments from the Shell of the Mali Ston Oyster and Their Application in Contemporary Printing Inks

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Pigments derived from natural sources have historically served as the primary raw materials for different types of paints. A significant portion of such pigments comes from seashells, which have been used in art across Asia and Europe for centuries. Oyster shells are rich in calcium carbonate ($CaCO_3$), which is used to produce white pigments, with applications in art, cosmetics, and the paint industry.

The Mali Ston oyster (*Ostrea edulis*) is a species of European flat oyster, highly valued for its quality and distinct flavor. It is traditionally cultivated exclusively in the Mali Ston Bay in Croatia and is protected by the European Union's designation of origin, ensuring authenticity and a strong connection to its geographical area of cultivation. The shells of the Mali Ston oyster hold potential as a sustainable alternative for natural pigment applications.

This study explores the possible applications of Mali Ston oyster pigments in the graphic arts industry and their potential significance for the preservation of Croatian cultural heritage and ecological sustainability. In this research, Mali Ston oyster pigments will be produced through processes of collection, cleaning, calcination, drying, grinding, and homogenization in binder and printing ink. Offset printing ink will be modified with natural pigments from Mali Ston oyster shells to determine their impact on the ink's colorimetric properties and potential applications.

The expected contribution of this research lies in the application of Mali Ston oyster pigments as fillers in the graphic industry. Potential applications also extend to certain types of coatings. The advantages of using these pigments include ecological sustainability, contributions to the circular economy, and the branding of Croatian products through authentic materials. Despite challenges such as production processes, grinding, and adaptation to printing techniques, pigments derived from Mali Ston oyster shells open new possibilities for innovation in graphic design, art, and the printing industry, while also contributing to the preservation of natural resources and the promotion of local heritage.

Keywords: natural pigments, Mali Ston oyster, printing inks, printing ink fillers

Evaluating 3D Scanning Potential for Art and Heritage Digitalization Using Mobile Phone Cameras

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3D scanning represents a broad spectrum of technologies capable of capturing the shape of a surface in 3D. Each of these technologies has specific advantages and drawbacks that ultimately make it suitable for a specific purpose. One such 3D scanning technology is photogrammetry. This technology differs from all others since it is entirely image-based and requires no specialized hardware – any properly captured set of images can be used to reconstruct a 3D shape, which makes it attractive for non-professional users. One aspect of photogrammetry that makes it very useful in art digitalization and conservation work is very high texture quality. This paper explores how ordinary mobile phone cameras can be used to create high quality 3D scans of objects of various sizes. It compares the quality output from two of the most widely known software for photogrammetry and offers insight into the relevance of certain imaging requirements on the quality of the results. Mesh and texture quality are evaluated, as are processing time and ease of use.

Keywords: photogrammetry, art, texture, 3D scanning

The Senj Glagolitic Missal: Historical, Technological, and Cultural Insights

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This study focuses on the Senj Glagolitic Missal, an incunabulum preserved in the archives of the Monastery of St. Francis in Cres, with the aim of analyzing its multifaceted significance in the context of printing history, the development of printing materials, and printing technology. Printed in the 15th century, the Senj Glagolitic Missal represents a key document of medieval religious and cultural heritage, testifying to the spread of literacy and education at the time. A comprehensive analysis of this incunabulum has revealed the specific characteristics of the materials used, the identification of printing techniques, the semantic meaning of the text, and a comparative examination with other incunabula.
The findings highlight the significance of incunabula in preserving written cultural heritage, religious content and their role in cultural and educational progress. Additionally, this research shows advancements in printing materials and technology, from early printed books to more complex printing processes. The results demonstrate that the Senj Glagolitic Missal not only holds great historical value but also provides insight into the technological transformations that shaped the printing industry. The study emphasizes the importance of preserving incunabula as a part of written cultural heritage and their contribution to the development of printing culture and technology, which has defined the history of human communication.

Keywords: Senj Glagolitic Missal, incunabulum, printing technology, history of printing, written cultural heritage

Posters

Permanent exhibition of the Museum of Contemporary Art

3D Photogrammetry as a Complementary Non-Invasive Method for Hidden Layer Detection in Heritage Paintings

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Recent developments in the field of non-invasive conservation techniques make photogrammetry a complementary tool to radiography and ultraviolet and infrared reflectography. By processing overlapping photographs with structure-from-motion algorithms, photogrammetry provides an accurate 3D mesh of an artwork's surface, revealing topographical details – cracks, pigment variations, and hidden sublayers – without direct contact or chemical intervention. The comparison of successive models also supports ongoing monitoring and enables early detection of degradation or instability.
In a study of the restoration of Carmelo Reggio's *Portrait of Marija Ghetaldi-Gondola* (c. 1812) from 2023, we removed the color information from the photogrammetry data and relied solely on the 3D mesh. This approach revealed subtle surface anomalies, initially suggested by the faint outline of an eye on the sitter's neck, and confirmed the presence of a second portrait beneath the visible layer using X-ray and infrared imaging. By refining our understanding of the structure of an artwork, photogrammetry is a method that can be used in minimally invasive conservation strategies and the preservation of historical detail. Photogrammetry thus proves to be a complementary, non-invasive method for the conservation of artworks.

Keywords: photogrammetry, heritage conservation, non-invasive techniques, minimally invasive restoration

Application of Thermography in Medieval Wall Painting Research in Slovenia

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Thermography or infrared thermography is a non-invasive research method, widely used in cultural heritage conservation, especially to study historical buildings, plasters, and wall paintings. By detecting infrared radiation emitted by surfaces, the method helps to identify underlying structures, material changes, hidden defects, moisture infiltration, and deterioration without physically touching or damaging the object.

We present three case studies of churches with medieval wall paintings in Slovenia, where thermography provided valuable data for their preservation efforts. Active thermography was applied, where the surfaces examined were heated either locally or entirely as evenly as possible to establish a temperature imbalance in the wall surface. The temperature becomes dependent on the thermal conductivity of the plaster, moisture, air bubbles under the plaster, and the type and method of construction. By measuring temperature differences on the wall surface during the heating or cooling process, it is possible to determine the structure directly below the surface, as well as in depth. The results were supplemented with classical methods like knocking and visual observation to choose the extent and level of conservation intervention.

In the pilgrimage church of St. Primus above Kamnik, best known for its early Renaissance wall paintings from 1504, the object of research was to determine the extent of areas of detachment within the wall painting. In the past conservation intervention in 1987 more than a hundred tubes for grout injection were inserted into plaster and left to be filled. Between 2014 and 2016 the most endangered plaster detachment parts were determined using thermography and the knocking test and consolidated, the tubes removed, and the wall painting conserved. In the Gothic church of St. Helen in Gradišče Pri Divači, where wall paintings from c. 1490 are preserved, preliminary analyses included thermographic research to determine the condition of painted surfaces. Larger areas of blistering were observed, as well as the position of stones and mortars under paint layers. The third case study is that of the Gothic church of St. Andrew in Gosteče, with wall paintings from c. 1400. Intervention was required due to the blistering of plaster on a large part of the south wall, and thermography was used to help locate hollow areas before they led to visible damage. The images also showed past conservation interventions, which contained newer plaster compared to the historic one.

Keywords: infrared thermography, conservation, medieval wall paintings, plaster detachment

Revealing the Secrets of the Mysterious Box from the Marian Column in Radlje Ob Dravi

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In 2020, the Marian Column was dismantled due to the high degree of stone degradation, resulting in a surprising discovery. On the interior of the base, a small niche containing a metal box with mysterious contents was discovered. The box and its contents were found to be in a state of significant deterioration. The following items were found in the box: a statuette of the Virgin Mary and Child made of organic material (bone or wood); a wooden cross with a silver loop; a coin; a roll of textile and several different types of textile fibers; and other organic materials.
Several scientific analyses were performed. X-ray fluorescence spectrometry (XRF) studies, which give information about the elemental composition of the materials, have shown that the box is made of tin-plated iron sheet. The rim is made of brass, and the latch is also made of tin-plated iron. To identify the organic materials optical microscopy was used, as well as to identify the morphology of textile fibers, and infrared spectroscopy analysis, which gives information about molecular structure, was also performed. Three different types of fabrics were identified, one felt made from wool and two silk fabrics of different weaving types. The coin was particularly notable. After restoration work, we found that the six-kreuzer coin from the Austrian Empire, dated 1795 with the letter A (Vienna), was made of lower-quality silver.
Microtomography (micro-CT) is a non-destructive microscopic technique that uses X-ray images to create a 3D representation of an object. The technique allowed us to examine the internal state of the box, box lid, statuette, coin, the roll of textile, and two paper fibers. The box and the box lid were both thoroughly corroded. Only the rim on the outside of the box remained in its original metallic form. The inside of the statuette showed cracks up to 2mm long, and smaller pores stretching all the way to the center of the object, while the coin showed only external corrosion damage in the form of localized patches 2mm in diameter. The letters, numbers and crest remained in good condition. The roll of textile was covered in high-density (likely metallic) particles both on the inside and outside, and part of the textile was soaked with the same dense material. Inside the roll was a separate piece of a textile fiber, like the ones found in the metal box.
The restoration of the Marian Column was completed in 2024, while in this year we hope to present the metal box with its contents at the Regional Museum in Radlje Ob Dravi.

Keywords: metal box, optical microscopy, infrared spectroscopy, XRF, CT

Digital Preservation and Comparative 3D Printing of an Iron Dagger from the Caska Necropolis

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This study explores the application of 3D scanning and printing technologies in the digital preservation and physical reconstruction of an iron dagger discovered in Grave 4 of the Caska necropolis on the island of Pag, a necropolis which is notable for its distinctive architectural features characteristic of the Liburnian region. The dagger, a significant archaeological find, was documented using non-invasive structured-light 3D scanning with an EinScan Pro 2X 2020 scanner. The obtained digital model was processed using the software provided with the EinScan Pro 2X 2020 scanner and Autodesk Meshmixer, with special attention given to overcoming challenges in scanning dark and patinated surfaces, including high dynamic range (HDR) adjustments for improved data capture.
In addition to digital preservation, this research investigates the accuracy and authenticity of 3D-printed replicas using three different printing technologies: fused deposition modelling (FDM), stereolithography (SLA), and binder jetting. The dagger was printed using a Prusa i3 Mk3 (FDM, Facilan™ C8), Elegoo Saturn 3 Ultra (SLA, Elegoo ABS-like Resin 3.0 Pro), and ZPrinter 250 (binder jetting, ZP150). The printed models were analyzed for dimensional accuracy, texture replication, and overall detail accuracy and authenticity compared to the original artifact.
A user evaluation survey was conducted during the opening of the exhibition *In the Shadow of the Waves: The Roman Necropolis in Caska* at the Museum of Ancient Glass in Zadar, providing insights into public perception of the replicas. The results highlight the advantages and limitations of each printing technology in archaeological replication, emphasizing the role of 3D scanning and printing in artifact conservation, museum display, and research accessibility. This study demonstrates the potential of digital and physical reconstructions in the broader framework of cultural heritage preservation and interactive storytelling for public engagement.

Keywords: 3D scanning, 3D printing, digital preservation, cultural heritage, non-invasive methods, archaeological replication, user evaluation, Caska necropolis

On the Paths of the Bari-Type: Graphic and Material Features of the Script

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As part of a PhD research project on Latin Paleography at the University of Bari "Aldo Moro" (funded by European grants), focusing on the so-called "Bari-type" Beneventan script, this poster presents the ongoing research, outlining its objectives, methodologies, and preliminary results, with a particular focus on the graphic and material analysis of the script, identifying its distinctive and defining features.

The investigation of the areas of diffusion of the "Bari-type" (10th–13th centuries), between southern Italy and Dalmatia, includes the compilation of a list of all handwritten books (including codices, rolls, and surviving fragments, palimpsests, and offsets) and documents that use this script, as well as their analysis. A fundamental step in the research is the understanding of the peculiar aspects of the script itself. The subsequent historicization of this evidence, which emerged from paleographical and codicological investigation, will allow for an examination of the trajectories followed by the "Bari-type", analyzing the contact relationships between the regions affected by this typification. Finally, the data collected will be used to create a specific database, complete with catalog descriptions and a set of images, in order to make this heritage more accessible.

Currently, the investigation estimates a corpus of approximately 260 manuscripts (considered as individual archival and library conservation units) to be examined through autoptic analysis in their respective institutions.

Specifically, in this phase of the research, the graphic and material data of the manuscript documents will first be analyzed (in order to base the study on dated and localized sources), and subsequently those of the manuscript books, for which the preliminary results of the investigation will be presented in the poster.

The analysis of this script, considered in relation to its connection with its territory of origin and its outward projection, offers us an account of the history of the places.

Keywords: enhancement of manuscript heritage, Beneventan script, paleography and codicology

Research on the Painting Emavs by Ivan Grohar

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The technique of the painter Ivan Grohar (1867-1911), who began as a church painter and became one of the most important Slovenian impressionists, has not yet been studied in detail or systematically. During the restoration of his early church painting *Emavs* from 1894, which is said to have been painted in oil, we decided to carry out in-depth research, due to the inconsistencies with the ascribed technique. We found out that the painting was painted with wax-oil paints.
The painting was subjected to technical photography, which is a standard procedure at the Restoration Centre before restoration work begins. We photographed both sides of the painting in visible light (VIS) and ultraviolet fluorescence (UVF), and additionally documented the front of the painting in visible side light (VIS RAK), infrared light (IR) and infrared light with false colors (IRFC), and ultraviolet fluorescence with false colors (UVFC). We also performed an X-ray of the entire painting after it was removed from the sub-frame.
The surface of the painting was examined non-invasively using a portable X-ray fluorescence (XRF) spectrometer, and the elemental composition of selected areas of the painting was determined. The layers of the samples taken from the painting were determined using optical microscopy and the material composition was identified using Fourier transform infrared (FTIR) and Raman spectroscopy.
The clearly visible color changes were analyzed using a spectrophotometer. The paint layers that have been covered by the decorative frame on the edge of the painting for 130 years are much more intense than the rest of the painted surface. Some of the exposed paints have faded unevenly, which is particularly visible on the blue clothes of Jesus, while others have darkened to a small extent. In most of the exposed areas, the saturation of the color tones has decreased, and many have also yellowed.
The research carried out is a part of the documentation of Grohar's Emavs and can be a source material for many experts. The recorded state of the painting before the restoration interventions will make it possible to monitor future changes. The technological and material composition of the painting will help in future restoration work. The representation of wax-oil paints in Slovenian paintings on canvas opens up a new field of study for art historians. For other researchers, it offers further research or comparative material.

Keywords: painting on canvas, wax-oil technique, non-invasive, invasive investigations

A **Historical Overview of the Use of the Dye Extracted from the Plant *Isatis Tinctoria L.***

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Isatis tinctoria L., known as dyer's woad (In Croatian: *bojadisarski vrbovnik*, *bojadisarski seč*), is a biennial or short-lived perennial herbaceous plant from the Brassicaceae family, native to Eurasia and particularly valued for its blue pigment indigotine. Since ancient times, woad has played an important role in textile dyeing and medicine. Its use is documented throughout Europe, the Middle East and North Africa. It was the most important raw material for producing blue dye for textiles until it was replaced by indigo in the 17th century, which marked a turning point in the European dyeing industry. From the 13th century onwards, some European regions experienced a significant economic boom thanks to the cultivation and processing of woad, and the trade in blue became very influential. Numerous historical documents pointed out the use of woad as a dye for textiles, in particular the Nuremberg Art Book from the 16th century. In Croatia, woad did not play as dominant a role as indigo. In Croatian folklore, blue was not as important as red and white, and its use in textiles only emerged later, after imported indigo (so-called *čivit*) became more available. However, it was mentioned that there was a plant that produced blue dye, which could indicate woad. An important aspect of blue textiles in Croatia was blue printing, a technique for printing patterns on textiles that developed in the 19th century. Although blue had no profound symbolism in Croatian folklore, it appeared on textiles in various contexts. In the Dinaric regions, blue was a status symbol for a married woman, while a blue scarf in the Zagreb area was a sign of great sadness. In Pokuplje, blue decorations on the clothing of older women and widows sometimes indicated readiness for a new marriage. In the 19th century, the traditional costume color *"požeško plava*" developed in the Požega Valley and blue garments, adopted from military uniforms, became part of formal and civilian men's clothing in Slavonia, Turopolje, and Posavina. In the fashion industry, blue has become the most popular color in the West since the late 18th century, across all social classes. Although in the past it was more associated with women as a symbol of chastity, since the 19th century it has been increasingly used by men because it is more discreet. In summary, blue textiles in Europe and Croatia have a long and complex history, characterized by changes in dye sources, dyeing techniques and cultural and symbolic meanings.

Keywords: natural dyes, *Isatis tinctoria L.*, indigotine, blue pigment

Heritage from Below: Contemporary Artistic Practices in Relation to Cultural Heritage at Gallery VN and Windows Gallery through the Examples of Goli Otok and Željezara Sisak

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In discussions and in the thematization of cultural heritage, its theory and analysis, institutional approaches often dominate, determining what is preserved, documented, and presented as worthy of collective memory. However, alongside official, canonized heritage, there exist unofficial, marginalized memories and material remnants of the past that bear witness to a specific historical period, social processes, methods of space utilization, and its transformations and repurposing. Through the analysis of artworks created and exhibited as part of the exhibition programs at Gallery VN and Windows Gallery (Zagreb City Libraries), this poster presentation will explore how unofficial heritage provides a space for questioning hegemonic narratives, memory politics, and relationships with space.

These works focus on the industrial complex of Željezara Sisak (Marijan Crtalić's work "Njih su dvojica, a mi smo sami" and Sandro Đukić's work "Željezara Sisak" in the artistic book *The Outworn Structure*) and Goli Otok as a political prison, a site of collective suffering and traumatic experiences (Sandro Đukić's "Goli express" and Ana Mušćet's "Na promjenu zraka"). By questioning the boundaries between institutional and unofficial heritage, this poster raises issues regarding the democracy of heritage policies, the role of contemporary art and of the community in its interpretation, but also the potential of heritage as a tool for social engagement and change.

In addition, using these artworks as examples, the poster will address the concept of heritage from below, which according to Ian J. Robertson refers to "forms of utilizing the past in the present that are minimally conditioned by the economy and, as such, can serve as cultural tools for counter-hegemonic practices." The artworks presented and exhibited within the framework of the exhibition program of these two galleries contribute to the visibility of the themes discussed in the professional context, as well as their deeper understanding and interpretation by the broader public. By weaving the theme through subjectivity, the works open the possibility for identification and the articulation of new relationships. A particular feature of both heritage sites is that they have been thematized by different artists in two different galleries, which underscores the importance of the subject matter.

Keywords: Goli Otok, Željezara Sisak, Marijan Crtalić, Ana Mušćet, Sandro Đukić

Non-Invasive Digitalization of the Bookbindings of Old and Rare Books from the Library of the Croatian Academy of Sciences and Arts as a Basis for Further Research

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A book's binding is primarily considered a covering material for manuscripts and books, but its importance is also decorative and plays a role in evaluating a book's appearance. Guided by this premise, we have selected several examples of different bindings from the collection of old and rare books of the Croatian Academy of Sciences and Arts Library, which we have decided to digitalize. The selected bindings date back to the 16th and 17th centuries from the regions of Italy, Austria, Germany, the Netherlands, and the Czech Republic, and are made of various materials: wood, parchment on cardboard, and leather with various decorations.
The goal is to digitize a portion of the selected material through non-invasive low light digitalization, which would enable more detailed research and study. With this type of digitalization, which is faithful to the original, the researcher will be able to get closer to the specifics of the depicted relief scenes, coats of arms of previous owners in blind embossing, and ornaments on the covers, as well as the texture, materials, and colors of individual copies without removing the original from the repository. This work will present the process of digitalization and its results in the form of high-quality digital copies which will be available on the portal DiZbi.HAZU.

Keywords: Library of the Croatian Academy of Sciences and Arts, collection of old and rare books, non-invasive digitalization, bookbinding, parchment binding

Effectiveness of the Multidisciplinary Approach for the Restoration of Cultural Heritage: The Case of the Fountain of Neptune of Palazzo Fizzarotti (Bari, Southern Italy)

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The protection of cultural heritage is a national and international priority and involves important economic, social, and cultural implications. In order to understand and prevent risk situations and the related degradation processes and to proceed with a restoration correctly, it is essential to know in detail the characteristics of the materials that constitute the asset to be protected and their interactions with the natural and anthropic environment. The aim of this research was to evaluate the state of degradation of a seahorse, a decorative stone element on the Fountain of Neptune located in the courtyard of Palazzo Fizzarotti, a historic building in the city of Bari (Southern Italy) in order to proceed with its restoration. The asset was in a very poor state of conservation not only due to prolonged exposure to environmental factors and irregular maintenance, but also because, being a structure in continuous contact with water (rainwater and seawater), it suffered accelerated deterioration, mainly biological, of the constituent material that compromised its integrity and also its aesthetics. And so, an accurate multidisciplinary chemical-petrographic-biological diagnostic campaign was conducted, from which it emerged that the stone material constituting the asset is a red ammonitic limestone (the so-called *Rosso Verona*) which can become porous at the surface and therefore very bioreceptive to biological contamination, which in this specific case comes from water. The biological colonizers identified both in the water and on the surface of the seahorse are bacteria (of the genera *Bacillus* and *Arthrobacter*) and fungi (of the genera *Penicillium* and *Aureobasidium*). This information has allowed us to identify the appropriate methods for eco-friendly cleaning and restoration. This study has confirmed the importance of a multidisciplinary approach that, through a global vision of the problems, allows us to adopt effective, eco-compatible, and long-lasting restoration methodologies.

Keywords: restoration, Neptune Fountain, limestone, biological contamination, stone bioreceptivity

The Influence of Watercolor Paper on Cyanotype Aesthetics and Fine Detail: A Material Perspective on Photographic Heritage

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Cyanotype is one of the earliest photographic techniques, discovered in 1842 by Sir John Herschel. As a part of photographic and technical heritage, cyanotype holds a significant place in the history of visual communication and reproduction. Originally used for duplicating technical drawings (blueprints), it later gained popularity as an accessible artistic medium due to its simplicity and characteristic Prussian blue tones. Today, it is recognized as an important element of intangible cultural heritage, linking science, art, and craft practices.

This study aims to contribute to a deeper understanding and preservation of this historical process by examining how different properties of watercolor paper—such as texture, absorbency, and surface treatment—affect the quality of cyanotype image reproduction. The goal is to identify which paper types best support the clarity, tonal depth, and aesthetic integrity of motifs typical for historical and artistic cyanotype applications.

Using papers of similar grammage but varied surface characteristics, high-contrast and fine-detail motifs were printed following a standardized cyanotype process. The final prints were analyzed in terms of detail retention, color uniformity, contrast, and overall visual quality. Special focus was placed on how the paper's structure affects the diffusion of the sensitizing solution and thus the sharpness and tonal transitions of the image.

This research, by examining material variables in a historical technique, supports the continued relevance and appreciation of cyanotype as part of our photographic and cultural heritage, providing useful insights for artists, conservators, and professionals working in heritage preservation.

Keywords: cyanotype, watercolor paper, image reproduction, aesthetics, cultural heritage

A Comparison of the Copy of Valvasor's *Glory* from Zagreb with Copies in Nuremberg and Novo Mesto

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This paper provides a description and visual comparison of the examined copies of the first edition of Valvasor's *Glory of the Duchy of Carniola* (*Die Ehre dess Hertzogthums Crain*), printed in Nüremberg in 1689 from the Metropolitan Library of the Archdiocese of Zagreb, which is today kept in the Croatian State Archives, with copies kept by the City Library in Nuremberg and in the Kapitel Library of the Diocese of Novo Mesto.
While examining the preserved copies of Valvasor's *Glory*, we found that the paper in the book in question, especially in terms of appearance, feel, and sound, differs from the average quality of the paper found in archival documents and books from the 17th and 18th centuries. We found that the paper is also different among other copies of the *Glory* from the first edition in 1689. We became interested in why this was so, so we undertook a literature survey and a detailed visual examination of the paper in preserved copies of this important book in Slovenian institutions, some Croatian, Italian, Hungarian institutions, and the copies kept in Nüremberg.
When examining the books, we found that the paper in the text block of the *Glory* from the Metropolitan Library in Zagreb is different from the text block in the City Library in Nüremberg and the Kapitel library in Novo Mesto. The findings will be presented in more detail in the paper.

Keywords: Valvasor, Die Ehre dess Hertzogthums Crain 1689, Zagreb, Nüremberg, Novo Mesto, paper, watermarks

AI Application for Copenhagen Transcription Symbol Recognition

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Lithuanian dialects developed over centuries due to limited communication between villages and towns. In recent decades, some dialects and their distinctive words have begun to disappear. To preserve this linguistic heritage, the Institute of the Lithuanian Language has documented words and sentences from various regions. For this purpose, the Copenhagen transcription, adopted in 1925 and adapted for Lithuanian by Jurgis Gerulis in 1930, was used. The Palemonas font was created for representing transcription signs. Today, this system is being replaced by TFA to build international-level databases. Thus, there is a need to digitize linguistic data recorded in Copenhagen transcription and make it more accessible, as well as to enable conversion into TFA.

The Geolinguistics Centre archive has collected large amounts of manuscript data since the mid-20th century. Some have been digitized earlier, and recently data are being organized with GIS systems. Manual systematization is time-consuming, which raised the need for automation. The aim of this research was to explore the potential of AI tools for recognizing dialectal texts in Copenhagen transcription, both printed and handwritten.

The research relied on an analysis of literary sources and archived portal data. Tools such as ChatGPT and Kraken OCR were tested, while Photoshop and Illustrator were used for manuscript processing. Scans were made with a Brother Mfc-j6955dw desktop scanner, and Python-supported Kraken OCR workflows.

To accelerate digitization, printed texts were first processed and UTF codes generated for AI training. ChatGPT achieved 95% reliability, after which handwritten texts were analyzed, supplementing encoding with character images. Kraken OCR was trained in parallel. Results were systematized and statistical insights with recommendations were provided. ChatGPT reached ~98.4% accuracy on printed transcription and ~89.5% on handwritten texts. Some dialects, such as Kaunas, were interpreted almost flawlessly, while others were harder due to numerous glyph combinations. Accuracy also depended on handwriting, card quality, and the aging of documents. Kraken OCR training was slower, as only small datasets could be processed at a time. Acknowledgment: We thank the Lithuanian Academic Council for their financial support.

Keywords: Lithuanian language, Copenhagen transcription, artificial intelligence (AI)

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