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TECHNICAL PAPERS PROGRAM
CONFERENCE SCHEDULE AND TABLE OF CONTENTS

TUESDAY 24 JUNE 2025

SHORT COURSE PROGRAM

8:45 – 10:45
SC04: Imaging Performance: Meeting Guidelines for Digital Collections
Instructors: Peter Burns, Burns Digital Imaging, and Don Williams, Image Science Associates

8:45 – 13:00
SC01: Camera Color Profiles: The Theory, Practice, and Pitfalls
Instructors: David R. Wyble, Gray Sky Imaging Inc., and Doug Peterson, Digital Transitions

11:00 – 13:00
SC05: Advanced Digital Imaging Techniques Applied to Cultural Heritage
Instructor: Miguel Ángel Martínez Domingo, University of Granada

14:15 – 16:15
SC08: OpenDICE for Imaging Quality Assessment
Instructor: Lei He, Library of Congress

SC09: Archival Negatives: A Novel Toolkit for Historically-accurate Inversions
Instructors: Alice Plutino and Luca Armellin, Imageese

SC10: Reference Assets-Bridging the Gap Between 2D and 3D Imaging
Instructors: Scott Geffert, Juan Trujillo, and Chris Heins, The Metropolitan Museum of Art

16:30 – 18:30
SC11: Advanced Concepts in Color Measurement
Instructor: David R. Wyble, Gray Sky Imaging Inc.

SC12: Can/Should AI Do That? Heritage Digitization Use Cases for AI
Instructors: Julie McVey, National Geographic Society, and Doug Peterson, Digital Transitions

SC14: Capturing Specularity with Kintsugi 3D and Camera-mounted Flash
Instructor: Charles Walbridge, Minneapolis Institute of Art

BEHIND-THE-SCENES TOURS

IS&T thanks the following institutions for opening their doors to attendees as part of the Behind-the-Scenes Tours program.

- Archivo de la Real Chancillería de Granada
- Archivo Histórico Provincial de Granada
- Department of Restoration and Conservation University of Granada
- Color Imaging Laboratory: University of Granada
- Escuela Técnica Superior de Arquitectura University of Granada
- Hospital Real
- Palacio de la Madraza
- Universitario de Cartuja

WELCOME RECEPTION

19:30 – 21:00

Join colleagues for a welcome drink and snacks at Peña la Plateria, a traditional flamenco club in the heart of the Albaicín, Granada's enchanting and historic neighborhood of winding cobblestone streets. While we won't see any flamenco dancing tonight, you'll enjoy the outdoor courtyard and a lovely view of Alhambra.

Address: Placeta de Toqueros, 7

WEDNESDAY 25 JUNE 2025

WELCOME AND OPENING KEYNOTE

Session Chair: Carolina Gustafsson, Stiftelsen Föremålsvård i Kiruna (Sweden)
09:00 – 10:00

Advancing Heritage Science: European Breakthrough Initiatives Driving Digital Innovation in Cultural Heritage, *Vania Virgili, director-level research technologist, Institute for Heritage Science, National Research Council of Italy (ISPC CNR) and appointed director general, European Research Infrastructure for Heritage Science (E-RIHS ERIC) (Italy)*

The digital transformation of heritage science is essential for improving analysis, preservation and transmission of cultural assets. The European Research Infrastructure for Heritage Science is at the forefront of this transformation, aiming to integrate physical and digital access to cutting-edge techniques and resources. Through its unique catalogue of services, E-RIHS includes four research platforms. ARCHLAB provides access to physical and digital archives, including datasets, reports, and reference materials from museums and research institutions. FIXLAB grants access to large-scale research equipment for advanced diagnostics and archaeometry, offering high-resolution 2D/3D imaging and spectroscopic analyses. MOLAB is a mobile lab for in-situ, non-invasive diagnostics of immovable heritage objects. Among others, it includes advanced imaging and image processing techniques such as multispectral, spatial, and 3D imaging. On top of this, a key opportunity is the current development of E-RIHS DIGILAB. DIGILAB is designed to manage, share, and enable the creation of new knowledge from data produced by ARCHLAB, FIXLAB and MOLAB. Its conceptual model ensures seamless dataflow, linking research questions, methods, instruments, data production, analysis and interpretation, and knowledge. DIGILAB leverages the heritage digital twin concept to offer cutting-edge data-driven services. National projects in France, Italy, Poland and Slovenia contribute to its development to foster the growth of the E-RIHS community. In this context, E-RIHS strengthens the vision of a cohesive digital ecosystem for heritage science with the European Cloud for Heritage OpEn Science, a key initiative in developing the EU's Cultural Heritage Cloud, connecting institutions and professionals across Europe.

SPECTRAL IMAGING

Session Chair: Yoko Arteaga, NTNU (Norway)

10:00 – 12:00

10:00 **Exploring the HYPERDOC Database: Advancing Hyperspectral Imaging for Historical Document Analysis,** *Ana B. López-Baldomero, Francisco Moronta-Montero, Miguel A. Martínez-Domingo, Yannick Lefier, Juan Luis Nieves, Javier Hernández-Andrés, Ramón Fernández-Gualda, Anna S. Reichert, Ana López-Montes, Teresa Espejo, Javier Romero, and Eva M. Valero, University of Granada (Spain)* **1**

The HYPERDOC database is a publicly available hyperspectral imaging resource for the analysis of historical documents and mock-ups of inks and pigments. It consists of 1681 hyperspectral datacubes, containing millions of reflectance spectra, covering the VNIR (400–1000 nm) and SWIR (900–1700 nm) spectral ranges, including different ink recipes and documents from the 15th to 20th centuries, preserved in two archives in Granada, Spain. We will present the data acquisition process and structure of the database, followed by a live demonstration of its functionality, guiding participants through its use. Additionally, three applications of the database will be summarized, including document binarization, ink classification using machine learning techniques, and ink aging analysis. The HYPERDOC database facilitates the integration of advanced imaging techniques into document analysis and preservation, contributing to the non-invasive study of historical materials.

10:15 **Multi-spectral Scanning for Analogue Film Digitisation: Addressing LED Variability in Spectral Band Selection,** *Mihaela Elizabeta Balica and Giorgio Trumpy, Norwegian University of Science and Technology (Norway)* **7**

The digitisation of analogue film is critical for cultural heritage preservation, as film deteriorates over time due to environmental factors and analogue projectors are becoming obsolete. Conventional RGB scanning methods fail to fully capture the spectral complexity of film, making multispectral imaging (MSI) a feasible alternative. However, MSI faces challenges due to the limited availability of narrow-band LEDs in certain spectral regions and inherent variability in LED emissions. Aiming to minimise colour reproduction errors in film scanning, this study investigates the optimisation of LED spectral band selection and the impact of LED spectra variability. Informed by the optimised bands, multiple market-based LED sets were further evaluated using MSI capture simulations, with the 7-band and 8-band setups achieving good colour accuracy and showing rather low sensitivity to LED spectral variability. A physical multispectral capture of a film photograph demonstrated a good agreement between the capture simulation and the real results.

10:30 **Adaptive Combined Method for Material Identification in Documents of Historical Interest,** *Eva M. Valero, Francisco Moronta-Montero, Ana B. López-Baldomero, Anna S. Reichert, Miguel A. Martínez-Domingo, Rosario Blanc, and Ana López-Montes, University of Granada (Spain)* **12**

Hyperspectral imaging has been widely and consistently applied in the field of Cultural Heritage for material identification. In the specific context of historical document analysis, it is frequently supported and complemented by additional analytical techniques. In this study, we propose a straightforward method for material identification that combines adaptive direct identification—using a reference library of visible and near-infrared spectral reflectance data for pigments—with a KNN classifier applied to an extended spectral range for inks and supports. The method has demonstrated a high degree of accuracy, successfully identifying materials present in both actual historical documents and mock-ups created following medieval techniques. Its performance is illustrated through three spectral image fragments extracted from the HYPERDOC project database.

10:45 – 11:30

COFFEE BREAK / EXHIBITS OPEN / POSTERS AVAILABLE FOR VIEWING

11:30 **Pigment Identification of Ortelius' Historical Maps using Hyperspectral Imaging,** *Zealandia S. N. Fatma, Hilda Deborah, Jon Y. Hardeberg, and Eleftherios Papachristos, Norwegian University of Science and Technology (Norway)* **18**

Hyperspectral imaging (HSI) has been widely used in the conservation studies of various cultural heritage (CH) objects, e.g., paintings, murals, and handwritten historical manuscripts. In this work, HSI is used to study painted historical maps, i.e., five maps of the Scandinavia region from the Ortelius collection preserved at the National Library of Norway in Oslo. Given knowledge of their colour application and usage, HSI-based pigment identification is performed, assuming several spectral mixing theories, i.e., pure pigments, subtractive, and additive mixing models. The obtained results are discussed, showing both the pure pigment and subtractive mixing model to be suitable for pigment identification in the case of watercolour applied on paper substrate.

11:45 **Heritage Science—Spectral Sustainability and Innovative Dissemination,** *Fenella G. France, Library of Congress (US)* . **24**

While spectral imaging has now been being utilized in cultural heritage for more than 20 years, there is still a lack of uptake by heritage practitioners. While some point to cost as an issue, it appears the real concern is that of communicating effectively with interested users—conservators, curators, scholars, heritage professionals. Many people are not aware of the range of types of information and data that can be captured and made available from collections, and the potential ease of interacting with the datasets. Since spectral imaging is essentially the next element of digitization and making heritage available in the digital realm, it seems necessary for more effort to be placed on shared knowledge of the spectral capture and processing methodology, so this becomes more accessible as a tool. Setting up a new spectral imaging system, communicating and creating networks for engagement, and addressing opportunities and challenges will be discussed.

3D: CAPTURE AND PROCESSING I

Session Chair: Lien Acke, J. Paul Getty Museum (US) and University of Antwerp (Belgium)

12:00 – 12:45

12:00 **Reference Assets: Leveraging Traditional Photographic Techniques to Improve 3D Object Renditions,** *Scott Geffert, The Metropolitan Museum of Art (US)* **29**

As 3D Imaging for cultural heritage continues to evolve, it's important to step back and assess the objective as well as the subjective attributes of image quality. The delivery and interchange of 3D content today is reminiscent of the early days of the analog to digital photography transition, when practitioners struggled to maintain quality for online and print representations. Traditional 2D photographic documentation techniques have matured thanks to decades of collective photographic knowledge and the development of international standards that support global archiving and interchange. Because of this maturation, still photography techniques and existing standards play a key role in shaping 3D standards for delivery, archiving and interchange. This paper outlines specific techniques to leverage ISO-19264-1 objective image quality analysis techniques for 3D color validation, and methods to translate important aesthetic photographic camera and lighting techniques from physical studio sets to rendered 3D scenes. Creating high-fidelity still reference photography of collection objects as a benchmark to assess 3D image quality for renders and online representations has and will continue to help bridge the current gaps between 2D and 3D imaging practice. The accessible techniques outlined in this paper have

vastly improved the rendition of online 3D objects and will be presented in a companion short course.

12:15 **Willem Witsen's Coat: From Restoration to Digital Preservation,** *Frans Pegt, Rijksmuseum (the Netherlands)* **A-1**
This article explores the multidisciplinary process behind the restoration and digitisation of Willem Witsen's painter's coat—an object of both artistic and historical value. Using techniques such as photogrammetry, 3D modelling, and 360-degree photography, the project aimed to digitally preserve the fragile coat while making it accessible to both researchers and the general public. The result is a high-quality digital surrogate that supports future conservation efforts and storytelling.

12:30 **Seeing the Unseen. The Selene Project for 3D Digitization of Cultural Heritage,** *John Barrett, Bodleian Libraries (UK); Jorge Cano, Carlos Bayod, Costanza Blaskovic, and Santiago del Bosque Arias, Factum Foundation (Spain); and Ana Carrasco-Huertas, University of Granada (Spain)* **36**
Funded by the Helen Hamlyn Trust, ARCHiOx – Analysis and Recording of Cultural Heritage in Oxford, is a collaborative project which has united Oxford University's Bodleian Libraries and the Factum Foundation. The Selene Photometric Stereo Scanner was conceived and developed by the latter and has, for the last three years, been piloted at the Bodleian Library. This technology has been used to reveal near-invisible text and artwork from originals from across Oxford University's collections. Renders created with the Selene PSS, have revealed what is difficult or impossible to record through conventional photography, and have allowed for the creation of physical facsimiles. This paper serves to demonstrate how Selene recordings have assisted in the research of cultural heritage originals and natural history specimens.

EXHIBITOR PREVIEWS

12:45 – 13:10

Session Chair: Laura Ramsey, Metropolitan Museum of Art (US)

Exhibitors Arkhênum, artefactual, ChannelScience, Iron Mountain Media and Archival Services, Max, NOA, Picturae, and VerusDigital share information about their products/services in short previews.

13:10 – 14:45

LUNCH BREAK ON OWN

3D: CAPTURE AND PROCESSING II

Session Chair: Lien Acke, J. Paul Getty Museum (US) and University of Antwerp (Belgium)

14:45 – 15:15

14:45 **Specialized 3D Meshes: Variations in Mesh Structures in Heritage Databases,** *Markus Sebastian Bakken Storeide and Sony George, Norwegian University of Science and Technology (Norway)* **42**
Mass 3D digitization of heritage objects is today heavily encouraged by various institutions. This is in an effort to measure and document objects for the future, use them for visualization and dissemination, and open up for the analytic tools that are available for 3D meshes. However, the structure required of a mesh depends heavily on the application, and the data might vary significantly based on the digitizing institution, object characteristics, and acquisition workflow.

In this work, we sample 3D data stored in several major open-access databases for 3D heritage data and analyze the content. We take a close



look at sampled mesh structures by computing various graph metrics, check some integrity measures, and evaluate their possible future use. Finally, we provide an overview of the use cases and interoperability of the meshes depending on results from the mesh structure analysis.

15:00 **You Do Not Know Until It is Not Usable: Metadata and Paradata Management for Photogrammetry Preservation and Archiving,** Irina Schmid and Elizabeth H. Day, The American University in Cairo (Egypt) **48**
Photogrammetry has greatly improved the recording, preservation, and accessibility of cultural heritage in archaeology and scientific research. The increased use of 3D modeling in heritage projects brings about significant challenges, especially in terms of data management. In this context, the challenges involve ensuring that digital models are reliable, traceable, and usable. Often, these concerns are disregarded until they impede access or reuse, affecting the long-term preservation and accessibility of cultural heritage data.

THREE-MINUTE INTERACTIVE PAPER PREVIEWS I

Session Chair: Irina-Mihaela Ciortan, NTNU (Norway)
15:15 – 15:35

Surveying Imaging Workflows and Software in Cultural Heritage, *Nina Eckertz, Hilda Deborah, and Jon Y. Hardeberg, Norwegian University of Science and Technology; and Irina C. A. Sandu, Munch Museum (Norway)* **56**
This work presents insights into the imaging workflow from cultural heritage domain experts, gathered from an online survey. Non-invasive 2D imaging technology has become a cornerstone in the analysis and documentation of cultural heritage artefacts. Techniques such as hyperspectral imaging (HSI) and X-ray fluorescence (XRF) can investigate material properties, artistic processes, and conservation states. Existing analysis and visualisation tools offer functionality for specific data types but lack integration for holistic multimodal analysis. To address these limitations, we conducted a structured survey targeting researchers and practitioners in CH working with imaging technology. The survey explores their workflows, imaging technology usage, and software preferences. This study identifies key trends, challenges, and feature requirements.

Revealing Erased Words: The Application of Multispectral Imaging to the Book of Hours 50,1,1 at the Brazilian National Library, *Alexandre Oliveira Costa[1], Isamara Carvalho[1,2], Alexandre Cruz Leão[1], Kethlin Barroso[1], and Márcia Almada[1]; [1]Federal University of Minas Gerais and [2]Brazilian National Library (Brazil)* **62**
Multispectral imaging has become an essential tool for the analysis, documentation, and visualization of cultural heritage materials and objects. This study explores the application of this technique to a 15th-century illuminated manuscript held at the Brazilian National Library (Fundação Biblioteca Nacional) in Rio de Janeiro. The manuscript, currently part of ongoing doctoral research, contains erased text due to censorship through scraping. The use of multispectral imaging, incorporating eleven different wavelengths across UV, visible, and IR spectra, proved highly effective in recovering the erased words "pape" and "thoma", thus confirming the hypothesis of scholar Damião Berge regarding the lacunae and linking the codex to a 16th-century historical event.

From Invisible to Visible: Scientific Imaging Applied in Drawings by Alberto da Veiga Guignard, *Larissa Lorrane Silva Oliveira[1,2], Alexandre Cruz Leão[1], and Alexandre Oliveira Costa[1]; [1]Federal University of Minas Gerais and [2]SECULT-MG - State Secretariat of Culture and Tourism of Minas Gerais (Brazil)* **68**
Non-invasive scientific imaging is increasingly becoming an important research tool in the study of cultural heritage objects, combining sustainability and preservation in a responsible and conscious manner. The purpose of this study is to make a legibility by digital restoration of two drawings by Brazilian modernist artist Guignard, dated 1956 and 1958, respectively, one created with ink and pen nib, and the other presumably with graphite. Both drawings have likely suffered from photodegradation, with almost total loss of visibility due to fading and erasure of the drawn lines. Scientific photography techniques were employed, including IR reflectance photography, visible light photography, UV fluorescence, Multispectral Imaging, transmitted light photography, raking light photography, and Reflectance Transformation Imaging (RTI). These techniques, used in combination, yielded positive results, enhancing legibility and revealing traces and details that were no longer visible to the naked eye.

Gloss Archiving with Normal Vector, *Shinichi Inoue[1], Yoshinori Igarashi[2], Shota Tsuneyasu[1], and Yoko Mizokami[3]; [1]Tokyo Polytechnic University, [2]CHUO Precision Industrial Co., LTD., and [3]Chiba University (Japan)* **73**
This paper proposes a method of gloss archiving using normal vectors. When archiving the gloss phenomenon of a material, it is important to record not only the reflected light intensity but also the gloss unevenness. This is because the gloss unevenness greatly affects the texture of the material. However, it has been difficult to quantitatively record gloss unevenness because they are dependent on the viewing direction and lighting. Gloss unevenness on mirror surfaces are mainly caused by irregularities in the normal direction. Therefore, we came up with a solution to archive the gloss unevenness phenomenon by recording the distribution of surface normal vectors. We are currently developing a apparatus to measure the distribution of surface normal vectors. Using this surface normal data, it will be also possible to reproduce gloss unevenness images using Computer Graphics technology.

Beyond Two Scribes? Column-based Writer Identification in the 1Qlsa[a] Scroll, *Tabita Lumban Tobing and Patrick Bours, Norwegian University of Science and Technology (Norway)* **77**
The 1Qlsa[a] Scroll, one of the most significant manuscripts among the Dead Sea Scrolls, has long been the focus of debate over whether it was produced by a single hand or multiple scribes. In this study, we introduce a column-based writer-identification framework that combines unsupervised clustering, character-level verification, and cross-dataset evaluation, without assuming any fixed number of scribes. Benchmarking our hinge–feature–based approach against the widely recognized FIREMAKER dataset reveals its strengths and weaknesses. This exploratory analysis not only offers fresh insights into 1Qlsa[a]'s scribal attribution but also underscores the need for richer or complementary features in future digital paleographic research.

15:35 – 16:15
COFFEE BREAK / EXHIBITS OPEN / POSTERS AVAILABLE FOR VIEWING

QUALITY AND GUIDELINES

Session Chair: Eryk Bunsch, Museum of King Jan III's Palace at Wilanow (Poland)
16:15 – 17:20

16:15 **Large Format Digitization with New Equipment and New Workflows in the Swiss National Library,** *Martina Hoffmann, Swiss National Library (Switzerland)* **83**
The Swiss National Library (SNL) operates a variety of different digitization projects for different kinds of materials. Besides newspapers, journals and monographies the SNL holds unique collections of writers' legacy and a great number of objects like posters, plans and drawings. Posters, plans and drawing are most of the time of a larger format than

the other objects. The digitization service has a duty to digitize them all. This paper shows the quest to find and utilize equipment large enough to digitize objects that exceed the usual sizes of books and newspapers. This is a case study of the Swiss National Library, and its vendors and equipment are named. It shows the process of getting new equipment and installing new workflows in the SNL for a specific use case of this institution. The SNL does not provide an assessment of the market or any statement on other brands or vendors. This paper is not a reinforcement of any brand or vendor but solely states the choices the SNL has made for herself. It is not to be read as advertising or recommendation of any kind.

16:30 **Survey on Mobile Phone Camera Use in Cultural Heritage Documentation,** *Leah Humenuck[1], Sony George[2], and Susan Farnand[1]; [1]Rochester Institute of Technology (US) and [2]Norwegian University of Science and Technology (Norway)* . **89**

Mobile phone cameras are imaging tools that are rapidly being adopted by various industries due to their portability and ease of use. Though not currently considered an adopted imaging tool for cultural heritage, there has been increased interest in their potential use within the field. To better understand how cultural heritage professionals considered mobile phone cameras as tools for various types of documentation, a survey was created and administered. A survey was designed and sent to cultural heritage groups involved with imaging with the goal of determining whether these types of cameras are practical imaging devices in circumstances where a studio or a DSLR may not be readily available. Initial results have shown a variety of responses and that mobile phones are being used for various types of documentation.

16:45 **Implementing a Quality Rating System for Legacy Digital Image Collections: A Case Study from the National Gallery of Art,** *Kenneth N. Fleisher, National Gallery of Art (US)* **95**

The National Gallery of Art developed a systematic approach to evaluate and categorize its extensive digital image collection spanning 20 years of technological evolution. This study addresses the challenge of inconsistent image quality resulting from varying capture technologies and methodologies over time. A four-tier rating system was created based on comprehensive analysis of capture devices, technical specifications, and workflow documentation. The system enables efficient assessment of image suitability for different applications while providing clear guidance for re-digitization decisions. The implementation includes integration with the institution's digital asset management system, offering a practical framework that other cultural heritage institutions can adapt for managing legacy digital collections while maintaining current quality standards.

17:00 **Metamorfoze Version 2.0,** *Hans van Dormolen, Independent Imaging Consultant (the Netherlands)* **99**

This year version 2.0 of the Metamorfoze Preservation Imaging Guidelines was published. Version 1.0 was published in 2012. The Metamorfoze guidelines are published by the KB, the National Library of the Netherlands.

Metamorfoze Version 2.0 is a technical and practical update of Version 1.0. And one of the three quality levels is completely rewritten for mass digitization with sheet-fed scanners.

With the technical update Metamorfoze Version 2.0 is in line with ISO 19264-1. With the practical update it is possible to use a broad range of technical targets.

The basic principle of the Metamorfoze guidelines: What you see is what you get, applies to all quality levels of the Metamorfoze guidelines.

17:15 **Closing remarks / evening on own**

THURSDAY 26 JUNE 2025

THURSDAY KEYNOTE

Session Chair: Todd Swanson, J. Paul Getty Trust (US)
9:00 – 10:00

Archiving the Invisible: Advanced Imaging to Recover Inaccessible Texts and Images in Historic Documents, *Lucía Pereira Pardo, researcher, Institute of Heritage Sciences (INCIPIT), Spanish National Research Council (CSIC) (Spain)*

Information has been accidentally or intentionally obscured in countless historic documents, photographs, and films. Specifically, legibility of texts and visibility of images may be compromised due to, on the one hand, deterioration of the support writing or image-forming materials and on the other hand, past human interventions. The massive scale of archival collections, organizations´ finite resources, severity of the damage, and the limits of current conservation methods are important obstacles to address this problem.

The goal of the project "The Museum of the Invisible – Spectral Imaging Techniques for the Digital Recovery of Deteriorated Heritage" is to use advanced imaging techniques as a possible solution to digitally unlock this inaccessible knowledge. The project has shown particularly promising results in archive collections with challenging conservation problems.

The applied methodology is comprised of a range of complementary imaging techniques, such as multiband and hyperspectral imaging in the UV-VIS-NIR range, X-Ray Fluorescence scanning, Raman imaging, and micro-CT-scanning. Image processing methods like binarization, Principal Component Analysis (PCA), or Spectral Angle Mapper (SAM) among others, are also investigated to improve the readability of the writing and the contrast of the images.

This talk provides an overview of the main results obtained so far, both on reference samples prepared in the laboratory and on historic case studies from a range of archival collections. Representative successful cases are shown, analysing the imaging techniques and processing methods that proved more adequate in each case, depending on the variety of document media and causes of information loss. Equally, unresolved challenges and further research needed to access the contents of these invaluable historic materials is discussed.

AI: GENERATING DATA

Session Chair: Julie McVey, National Geographic Society (US)
10:00 – 11:45

10:00 **JIST-first: A Building-block Approach to Character-level Writer Verification on the Great Isaiah Scrolls,** *T. Lumban Tobing and P. Bours, Norwegian University of Science and Technology (Norway)* . . . . . **see JIST 69(2)/ pg. 208**
DOI: 10.2352/J.ImagingSci.Technol.2025.69.2.020401

This study presents a novel character-level writer verification framework for ancient manuscripts, employing a building-block approach that integrates decision strategies across multiple token levels, including characters, words, and sentences. The proposed system utilized edge-directional and hinge features along with machine learning techniques to verify the hands that wrote the Great Isaiah Scroll. A custom dataset containing over 12,000 samples of handwritten characters from the associated scribes was used for training and testing. The framework incorporated character-specific parameter tuning, resulting in 22 separate models and demonstrated that each character has distinct features that enhance system performance. Evaluation was conducted through soft voting, comparing probability scores across different token levels, and contrasting the results with majority voting. This

approach provides a detailed method for multi-scribe verification, bridging computational and paleographic methods for historical manuscript studies.

10:15 **A Hybrid 3D Laser Scanning and Machine Learning System: Paving the Way for Autonomous Braille Digitization,** *Lei He, Library of Congress (US)* **103**
The Library of Congress has been conducting the Braille digitization to preserve its tactile braille music collection electronically. In this project we scan braille papers with a 3D laser sensor to obtain the coordinates of the recto/front and verso/back dots, which are fed into our digitization program for dots pattern recognition. Our software group the dots in different lines and further into different characters. Specifically, each dot in a character is identified according to the relative positions to its local neighbors in the same character, based on which the character is recognized and the corresponding ASCII glyph code is written into the final output file. Experiments on different collections show the robustness of our system.

10:30 – 11:15
COFFEE BREAK / EXHIBITS OPEN / POSTERS AVAILABLE FOR VIEWING

11:15 **Simple and Effective ASR for Archives,** *Anssi Jääskeläinen, South-Eastern Finland University of Applied Sciences (Finland)* **107**
Archives are traditionally identified as holders of text-based information. However, they also possess audio and video materials, which are the focus of this paper. In archival institutions, the absence of transcriptions for audio and video materials presents significant challenges. These materials often hold historical, cultural, and research value, but without transcriptions, their accessibility and usability are limited. The lack of transcriptions makes it difficult to index and search the content, hindering effective utilization. While existing ASR (Automatic Speech Recognition) technologies can assist, these may suffer from mediocre accuracy, especially with older or poor-quality materials. This work addresses the challenge by utilizing state of the art multilingual LLM (Large Language Model), simple to use UI (User Interface) and GPU (Graphics Processing Unit) ready containers to create a simple and effective multilingual transportable ASR module.

11:30 **AI-driven Metadata Extraction and Semantic Search for Audiovisual Archives,** *André Rattinger, Giacomo Alliata, Kirell Benzi, and Sarah Kenderdine, EPFL (Switzerland)* . . . **112**
ArchiveVault is a next-generation digital archiving system designed to enhance access to audiovisual collections through automated metadata extraction and advanced retrieval mechanisms. Traditional archiving methods are labor-intensive, requiring extensive manual annotation that often leads to incomplete and inconsistent metadata. ArchiveVault addresses this challenge by employing AI-based transcription, named entity recognition (NER), speaker diarization, and pose detection to extract structured metadata from audiovisual archives. This allows for rich, searchable metadata that improves retrieval precision beyond traditional keyword-based approaches.

By leveraging state-of-the-art AI techniques, ArchiveVault enables researchers, archivists, and content creators to perform semantic searches across large collections, discovering moments of interest more effectively. Our deployments in a national broadcast archive (RTS) and the Olympic Games media collection demonstrate how AI-driven processing unlocks previously inaccessible content, from spoken-word analysis to pose-based retrieval for sports footage.

AI: LEVERAGING DATA

Session Chair: Miguel Ángel Martínez Domingo, University of Granada (Spain)
11:45 – 12:30

11:45 **A White-box Machine Learning Model for Dating Archival Materials Using IR Spectroscopy,** *Hend Mahgoub[1], Patrick Layton[2], Sonja Svoljšak[3], Jasna Malešič[3], Johannes Tintner-Olifiers[2], and Matija Strlič[1]; [1]University of Ljubljana (Slovenia), [2]Academy of Fine Arts, Institute of Natural Sciences and Technology in the Arts (Austria), and [3]NUL, National and University Library of Slovenia (Slovenia)* **A-3**
This study highlights how infrared (IR) spectroscopic techniques, combined with machine learning (ML), can transform the dating of archival materials. By integrating near-infrared (NIR) and Fourier-transform infrared (FTIR) spectroscopy with ML methods, we establish correlations between spectral signatures and paper aging markers and composition. The Ancient Book Crafts (ABC) project demonstrates the practical applications of these techniques, confirming their potential to produce accurate, data-driven dating models. A dataset of 100 well-dated paper objects from the National and University Library (Slovenia) was analyzed to develop predictive models for dating. Initial results show the superior accuracy of NIR in detecting bulk aging effects, while FTIR-ER proves success as a valuable non-contact tool compared to ATR for dating and surveying archival materials. Future advancements in spectral preprocessing, model optimization, and interdisciplinary collaboration will further refine this approach, ensuring widespread applicability across cultural heritage collections and supporting evidence-based conservation strategies.

12:00 **AI-based Indexing for Secure and Efficient Archival Digitalization,** *Julia Sjöholm, The National Archives of Sweden (Sweden)* **A-5**
This extended abstract presents a full-scale production system developed by the National Archives of Sweden for large-scale digitization and AI-assisted indexing of over 54 million pages of property-related documents. The system, operational since May 2024, efficiently extracts metadata at scale while ensuring appropriate protection of sensitive archival content, maintaining efficient processing times.

The system architecture covers the entire digitization chain: physical document handling, high-speed scanning at 290 images per minute, AI processing, automated validation, and manual review of approximately 10% of the predictions. The AI-based indexing pipeline includes object detection (YOLOv9 with 0.80 precision and 0.90 recall), handwriting recognition (TrOCR with a CER of 0.0145), and automated validation, achieving an 82% efficiency gain compared to manual indexing.

Continuous model development through offline retraining using quality assurance feedback enhances performance over time. Early tests with a Donut model, integrating detection and recognition without bounding boxes, are promising and allow reuse of previously processed data.

The system maintains data sovereignty through internal processing and secure access control, with potential data-sharing collaborations being explored with the Swedish Mapping, Cadastral, and Land Registration Authority (Lantmäteriet). The architecture provides a scalable and reusable framework for public institutions aiming to combine large-scale digitization and internal network security. This document outlines the technical implementation, performance evaluation, and future development strategies.

12:15 **Enhancing Archival Transparency with AI: A RAG-based Case Study on Cinematic Heritage,** *Enea Ahmedhodzic and Andrea Mario Trentini, Università degli Studi di Milano (Italy)* . **117**
Cinematic archives preserve an invaluable heritage, yet accessing their content is often challenging due to data fragmentation, inconsistent standards, and the absence of user-friendly tools. Even when materials are available, consultation may require archival staff or specialized knowl-

edge. This paper introduces Valter, a prototype AI chatbot developed as a case study for the Film Center Sarajevo (FCS), which explores how retrieval-augmented generation (RAG) can support transparency and accessibility in under-resourced archival settings. The system uses semantic search over multilingual embeddings to retrieve relevant information and generate answers in natural language. While still under development, Valter demonstrates the potential to enhance resource discovery and metadata validation, offering a replicable approach that could inform future digital access strategies across similar institutions.

12:30 – 14:00
LUNCH ON OWN

STEWARDSHIP, KNOWLEDGE, AND CONNECTION

Session Chair: Todd Swanson, J. Paul Getty Trust (US)
14:00 – 15:15

14:00 **JIST-first: Writing for the Future. What are the Options?,** *Barry M. Lunt, Felipe Riviera, Joshua Santos, Armando Carreon, Joshua Isaacson, and Matthew R. Linford, Brigham Young University (US)* . . . . . **see JIST 69(2)/ pg. 218**
DOI: 10.2352/J.ImagingSci.Technol.2025.69.2.020402
An ideal archival storage system combines longevity, accessibility, low cost, high capacity, and human readability to ensure the persistence and future readability of the stored data. At Archiving 2024, the authors' research group presented a paper that summarized several efforts in this area, including magnetic tape, optical discs, hard disk drives, solid-state drives, Project Silica (a Microsoft project), DNA, and projects C-PROM, Nano Libris, and Mil Chispa (the last three being the authors' research). Each storage option offers unique advantages in each of the desirable characteristics. This paper provides information on other efforts in this area, including the work by Cerabyte, Norsam Technologies, and Group 47 DOTS, and an update on the authors' projects CPROM, Nano Libris, and Mil Chispa.

14:15 **Digital Object Authenticity: Creating a Standard Practice,** *Julie McVey, National Geographic Society (US); Doug Peterson, Digital Transitions (US); and Ottar A.B. Anderson, Intermunicipal Archive of Møre og Romsdal (Norway)* **A-8**
Galleries, Libraries, Archives, and Museums do not currently have a standardized, simple way to communicate digital surrogate quality to users through standard, shared metadata fields. Creating these shared standard fields and implementing content authenticity tools in an agreed-upon and widely adopted data model will allow for greater transparency and institutional trust. The Digital Object Authenticity Working Group (DOAWG) aims to work with existing organizations and standards commonly used in the heritage field to create a cultural heritage object authenticity standard. We believe this goal is best accomplished by bringing cultural heritage professionals together to facilitate a timely and thorough approach to establishing this standard practice in institutions across the world.

14:30 **Embodying Scholarly Annotations in the Network of Digitized Archives,** *Tsz-Kin Chau and Sarah Kenderdine, Swiss Federal Technology Institute of Lausanne (EPFL) (Switzerland)* **124**
The increasing availability of digitized archive presents new opportunities for scholarly research, yet effective reuse of these resources requires infrastructure that is interoperable with the open data. This paper presents a novel annotation platform for the scholarly research of visual material, based on a customization of the ResearchSpace platform. By directly integrating images served via the IIIF Image API (v2v3), the system ensures a high level of digital provenance and source reliability, crucial for research in history-oriented humanities.

The paper outlines the platform's technological framework, highlighting how its architecture fosters deep scholarly engagement with digitized materials and exploring the potential applications of annotation outcomes. Additionally, it discusses the challenge of streamlining the connection between researchers and digitized archives. Future improvements will focus on automating metadata integration and tackling interoperability challenges across diverse data models.

14:45 **Building Online Expert Networks to Support Continuous Learning—Case Digitisation Experts in Finland,** *Miia Kosonen, South-Eastern Finland University of Applied Sciences (Finland)* . **130**
Online networks are a highly topical issue for continuous learning and also for management policy development within the cultural heritage sector. In our project, a well-known framework for community building was adopted and tested in practice: firstly, we conducted a needs assessment and planned usability and sociability practices in parallel. We explored how to succeed in building an online expert network, relying on careful needs assessment, openness, a participatory approach and identifying lead users. Our case highlights the significance of data safety, encouraging networks to rely on platforms where the user community manages its own knowledge base. We believe our case has important implications for cultural heritage professionals internationally, but it is also insightful for other expert groups and professional sectors.

15:00 **Preservation, Security & Access Through Documentation: A Collaborative Exchange Between the Met and the National Museum Lagos,** *Chris Heins and Juan Trujillo, The Metropolitan Museum of Art (US)* **134**
In late October 2024 a team of 6 staff from the Metropolitan Museum of Art in New York travelled to Lagos Nigeria to participate in a collaborative exchange with the staff of the National Museum Lagos. While there were multiple goals based on a two-way exchange of knowledge between the institutions, this paper will mostly focus on one of the primary goals of the Met team which was to provide photographic gear and training to enable the staff of the National Museum Lagos to produce high-quality photographic documentation of their vast and important collection of West African art.

BEHIND-THE-SCENES TOURS

Tours start at 17:00 or 17:30 and end at 18:30.

CONFERENCE DINNER

20:15 – 23:30

After a taking a Behind-the-Scenes tour or exploring Granada and taking a rest or enjoying a "merienda", a late afternoon/early evening snack or tapa, join colleagues at the historic Carmen de los Chapiteles, a lovely traditional house and garden located below the Generalife, the former residence of the sultans of Alhambra. Known for centuries as the House of the "Rich Moor Abu-Jamr"—a unique, bohemian, libertine, poet, hedonist, and generous doctor who altruistically treated the poor and collected old books—the venue offers exquisite, night views of Alhambra. Cocktails are followed by a delicious Spanish dinner at a traditional dining time.

Address: Carmen de los Chapiteles,
Cam. Fuente del Avellano, 4, Centro

CLOSING KEYNOTE

9:00 – 10:00

Session Chair: Carolina Gustafsson, Stiftelsen Föremålsvård i Kiruna (Sweden)

Navigating Through a Sea of Information: Towards a More Multifaceted View of the World, *Johanna Fries Markiewicz, international coordinator, The National Archives of Sweden (Sweden)*

The invasion of Ukraine has made it evident that common knowledge about Ukraine in the "West" has been dominated by an alternative narrative that suggests that Ukraine is not a nation in its own right, with its own culture, history, and right to self-determination. This discovery of an inherited distortion in knowledge has opened up new forms of knowledge production where Ukraine is now the subject, not the object, of other narratives. The process highlights the need to diversify and represent not only Ukraine, but also many other voices and communities of Eastern Europe, the Baltic, the Caucasus, Central Asia, and others.

This shift in focus has led to an interest in researching Ukraine's history outside Ukraine, for example, in archives in Sweden and other Western countries. New sources of history are found, and new research is made possible. The digitization of archival sources is important in this process and making the historical sources freely available to the public, without restrictions on their use or distribution, is a natural standpoint, a practice closely linked to the principles of transparency, accountability, and collaboration. However, at the same time, Russia continues to use history as a tool for domination and confrontation and will, if possible, misuse the data.

Touching upon the themes of the conference—science, sustainability, and security—and with examples from a current project that the Swedish National Archives, together with Wikimedia and cultural heritage institutions in Ukraine, is working on right now, the presentation reflects upon the power of digitization as a way to give voices to histories not told, paving the way and contributing to a more multifaceted view of the world. Questions are also raised about how to secure the narratives built upon open data when there is not an academic process that reviews the writings. In the archives, single documents are contextualized by their physical position, and there is a set of material metadata that is taken account by the researchers. When publishing single documents online, for example on Wikimedia, there is a risk of losing the archival context and therefore opening it up for misuse. How is it possible to avoid disinformation and misuse and keep academic standards in the world of open data and accessibility?

THREE-MINUTE INTERACTIVE PAPER PREVIEWS II

Session Chair: Irina-Mihaela Ciortan, NTNU (Norway)

10:00 – 10:20

Tweaking Mainstream Open-source OCR Engine for Minority Languages, How To?, *Tuomo Räisänen and Anssi Jääskeläinen, South-Eastern Finland University of Applied Sciences; and Atte Föhr, National Archives of Finland (Finland)* **140**

The digitization of historical documents is vital for preserving cultural heritage, yet mainstream OCR (Optical Character Recognition) systems often fail to support minority languages due to limited training data and language-specific models. This study explores how open-source OCR frameworks can be adapted to overcome these limitations, focusing on Finnish and Swedish as case studies. We present a practical methodology for fine-tuning PaddleOCR using a combination of manually annotated and synthetically generated data, supported by high-performance computing infrastructure. Our enhanced model significantly outperforms both Tesseract and baseline PaddleOCR, particularly in recognizing handwritten and domain-specific texts. The results highlight the importance of domain adaptation, GPU acceleration, and open-source flexibility in building OCR systems tailored for under-resourced languages. This work offers a replicable blueprint for cultural institutions seeking locally deployable OCR solution.

Reconceptualizing Mass Digitization Through a Pragmatic Lens: The Move from Whole Collections to Selective Highlights, *Douglas Emery and Roxanne Peck, Hoover Institution Library & Archives (US)* **A-11**

The Hoover Institution Library & Archives (HILA) embarked on an ambitious mass digitization program, known as the Digital First Initiative (DFI) in 2019. After two years of planning, infrastructure development and hiring staff, the program launched focusing on digitizing whole archival collections and replicating the physical reading room experience online. By 2024, the DFI program had digitized three collections. Through an assessment of DFI's effectiveness, engaging staff in a pilot program to evaluate more efficient workflows along with a shift HILA's vision for digitization, the DFI program transformed from digitizing whole collections to selective highlights. These changes resulted in increased staff productivity, more diverse collections online, improved staff relationships, and clearly established priorities.

State of Open Data in Government Ministries: The Case of the United Arab Emirates, *Martin Critelli, Mehluli Masuku, and Samson Mutsagondo, Sorbonne University Abu Dhabi (United Arab Emirates)* **145**

Open data has become a multidisciplinary concept attracting different players and professionals across the globe. Given its benefits, countries are thriving to provide a conducive environment for such open data. The study examines the extent of open data deployment and presence of open data laws, policies and regulations in government ministries in the United Arab Emirates. This article analyses national and federal policies and regulations concerning open data. The study revealed the presence of a strong regulatory framework for data packaging, reusability, accessibility and the presence of open data in most government ministries. Given that most governments are still grappling with open data implementation, the UAE serves as one of the rich cases for open data deployment by government, deepening access to public data.

Digitizing Cultural Heritage: Exploiting the Gap Between Standards and Individual Approach, *David Stecker, National Gallery Prague (Czech Republic)* **150**

The digitization of cultural heritage focuses on finding a way to record reality as faithfully as possible and to achieve maximum conformity in the representation of the original object in the digital world. To this end, digitization standards and recommendations have been developed that describe best practices for creating a faithful digital representation, ideally a digital surrogate. However, reality cannot be contained in a single digital file; to better describe it we need to create several, each representing different characteristics of the original object. This brings me to the topic of the paper, I want to focus on the space that lies between the original object and its standardized representation. Therefore, at the National Gallery in Prague we are developing a more complex approach that combines standardization with individual imaging. We focus on capturing different aspects of the work using specific lighting techniques and capture methods. We are trying to document these individual approaches as a complement to the standards, thus enriching the metadata of the object. The aim is to disrupt the concept that a single digital document can replace the original, and to show that complex digitization requires a wide range of documented and repeatable approaches that are applied variably to individual objects.

MISHA3D—Three-dimensional Surface Capture with the MISHA Multispectral Imaging System, *James Ferwerda, Juilee Decker, and David Messinger, Rochester Institute of Technology (US)* **155**
In this paper we introduce MISHA3D, a set of tools that enable 3D surface capture using the MISHA multispectral imaging system. MISHA3D uses a novel multispectral photometric stereo algorithm to estimate normal, height, and RGB albedo maps as part of the standard multispectral imaging workflow. The maps can be visualized and analyzed directly, or rendered as realistic, interactive digital surrogates using standard graphics APIs. Our hope is that these tools will significantly increase the usefulness of the MISHA system for librarians, curators, and scholars studying historical and cultural heritage artifacts.

INTERACTIVE POSTER PAPER SESSION

10:20 – 11:30

Engage in meaningful conversations with the authors of the Interactive Papers over coffee and learn more about their work.

DIGITIZATION AND ACCESS

Session Chair: Ty Popko, The Walt Disney Archives (US)

11:30 – 12:15

11:30 **Providing Digital Access to the Freedmen's Bureau,** *Emily Cain, Smithsonian Transcription Center; Hollis Gentry Brown, Smithsonian Libraries and Archives; and Douglas Remley, Jill Roberts, and Kamilah Stinnett, National Museum of African American History and Culture (US)* **159**
The National Museum of African American History and Culture's Freedmen's Bureau Project is a comprehensive initiative that has provided digital access to the Freedmen's Bureau records. Previously, this important collection could only be accessed in person through the National Archives and Records Administration, with no way to search for specific people or topics. Smithsonian staff have worked with the public to index and transcribe the records to provide free full-text access to these invaluable records. To date over 600,000 pages of Freedmen's Bureau records have been collaboratively transcribed by more than 60,000 individual volunteers. This data has been made available to the public for research in the Freedmen's Bureau Search Portal. This groundbreaking search application is the result of more than a decade of data creation, processing, and cleaning; transcription; community engagement; and historical and genealogical research. The work of Smithsonian staff is ongoing and emerging technologies present exciting opportunities to expand access and continue to enable meaningful discoveries.

11:45 **A Matter of Size, Scope, and Significance: Archival Processing and Mass Digitization of the Johnson Publishing Company Archive,** *Steven D. Booth, Getty Research Institute; and Nathan Anderson, Jeanine Nault, and Luis J. Villanueva, Smithsonian Institution (US)* **165**
Acquired in 2019 by a consortium of philanthropic and cultural heritage organizations, the Johnson Publishing Company (JPC) Archive is co-owned by the Getty Research Institute (GRI) and Smithsonian National Museum of African American History and Culture (NMAAHC). Dating from 1942, when John H. and Eunice W. Johnson founded the company, to the 21st century, the JPC Archive contains over 4 million photographs of published and unpublished works documenting the Black experience, some of which were featured in JPC's 14 magazines, most notably JET and Ebony. In addition to the historically significant events and behind-the-scenes moments depicted, the Archive presents an unmatched and unique record of many facets of the life, work, and contributions of Black individuals, communities, groups, organizations, and businesses. Working collaboratively across the United States (from Los Angeles to Chicago to Washington, DC), these two large cultural heritage institutions currently co-steward this collection, with each focusing on their strengths to bring this remarkable and unique collection to the public.

12:00 **Books are Stubborn Things,** *Amy McCrory, The Ohio State University Libraries (US)* **173**
"Facts are stubborn things, and whatever may be our wishes, our inclinations, or the dictates of our passions, they cannot alter the state of facts and evidence." –John Adams
This paper addresses the complexities of book digitization. In many ways, books defy easy categories that would allow the uncomplicated workflows many people assume are possible. I will examine how this unavoidable fact impacts planning and implementation of regularized book digitization, highlighting common problems and describing how they may be resolved or avoided altogether through careful planning. The paper includes a description of how my organization used a pilot project as an opportunity to build a coordinated workflow encompassing multiple activities across several departments within a large university library.

PHOTOGRAPHIC MEDIA: PROCESSING AND ANALYSIS

Session Chair: Eva Valero Benito, University of Granada (Spain)

12:15 – 15:30

12:15 **From Negatives to Positives: Modeling the Photochemical Printing Process,** *Giorgio Trumpy, Norwegian University of Science and Technology, and Ottar A. B. Anderson, Intermunicipal archive of Møre og Romsdal (Norway)* **178**
Most analog color photographs were captured on film negatives. This study presents a scientifically validated workflow for digitizing and inverting color negatives to produce digital positives that closely emulate traditional enlarger prints. A custom imaging system with narrow spectral bands, designed to match the spectral sensitivities of photographic paper, was tested against a conventional digitization method. Final color images were computed based on the spectral densities of the paper's image-forming dyes, simulating the photochemical printing process. Results demonstrate that aligning digitization spectral bands with photographic paper characteristics improves inversion accuracy. This research lays the foundation for enhanced archival preservation of color negatives and provides a method for generating digital positives that closely match the aesthetic of original prints.

12:30 **Digital Image Processing for Identification and Classification of Historic Photoreproductive Processes Used in Architectural and Technical Drawings based on Color Analysis,** *Manto Sotiropoulou and Vasiliki Kokla, University of West Attica (Greece)* **182**
This research explores the application of image color analysis techniques to identify and classify historic photoreproductive processes—such as blueprinting, diazotype, and other early photographic reproduction methods—based on the color signatures they leave on architectural and technical drawings. The objective is to develop a systematic approach for automatically detecting the specific process used in the reproduction of these drawings, which is critical for preservation, restoration, and analysis in historical studies.

Digital microscopy is employed to examine original 20th century photoreproductions from a historical technical company's archive in Greece. The processes examined are cyanotype, both positive and negative, diazotype of black and red color of line and Gel- lithography of black and brown lines. The visual features of photoreproductions are

analyzed using computational pattern recognition techniques that emphasize the color of lines and type of printing process. The findings computational analysis are cross-referenced, and the resulting variables conclude the classification of prints, according to their colors. The results will contribute to the creation of an effective and accurate identification system for both photographic and photomechanical prints.

12:45 – 14:15
LUNCH BREAK ON OWN

14:15 **Exploring Experimental Machine Learning in Film Restoration,** *Fabio Paul Bedoya Huerta, Duplitech (Peru)* **187**
The challenges of film restoration demand versatile tools, making machine learning (ML)—through training custom models—an ideal solution. This research demonstrates that custom models effectively restore color in deteriorated films, even without direct references, and recover spatial features using techniques like gauge and analog video reference recovery. A key advantage of this approach is its ability to address restoration tasks that are difficult or impossible with traditional methods, which rely on spatial and temporal filters. While general-purpose video generation models like Runway, Sora, and Pika Labs have advanced significantly, they often fall short in film restoration due to limitations in temporal consistency, artifact generation, and lack of precise control. Custom ML models offer a solution by providing targeted restoration and overcoming the inherent limitations of conventional filtering techniques. Results from employing these local models are promising; however, developing highly specific models tailored to individual restoration scenarios is crucial for greater efficiency.

14:30 **From Dyes to Digital: A Scientific Reconstruction of Early Colors,** *Chiara Campagnari, Università degli Studi di Milano (Italy), and Alice Plutino, University of Amsterdam (the Netherlands)* . . . **191**
The growing interest in early films highlights the need for their preservation and digital restoration. Scientific methods are essential for analyzing historical coloring techniques and key characteristics for both physical conservation and digital reproduction.

This study applies colorimetric analysis to two early nitrate-based 35mm films—Voleurs de bijoux mystifiés (1906) and Satan fait la noce (1907)—to examine imbibition and au pochoir coloring methods. Spectral transmittance measurements enabled preliminary dye identification, while colorimetric data informed an accurate digital restoration. This approach aims to (1) expand research on film dyes characterization and (2) establish a material-based method for digital color restoration. By reducing handling of analogue materials, it minimizes deterioration risks, ensuring long-term preservation while maintaining accessibility for study and appreciation.

14:45 **Automatic Restoration of Historical Stereoscopic Photographs for 3D Visualization at Scale,** *Dhruva Gowda-Storz and Sarah Kenderdine, EPFL (Switzerland)* **197**
Vast archives of stereographic photographs from the 19th and 20th centuries survive in collections worldwide. While extensively digitized, these artifacts remain largely inaccessible in their intended three-dimensional form. Contemporary stereoscopic displays offer ideal platforms for experiencing these historical media, yet a significant barrier persists: the labor-intensive process of restoring deteriorated stereographs for comfortable viewing. This paper addresses this challenge through two approaches: first, establishing a comprehensive framework for manual stereograph restoration that balances historical authenticity with viewing comfort; second, presenting our ongoing development of an automated pipeline that leverages recent advances in computer vision. Our approach aims to dramatically reduce the time and expertise required for restoration, potentially enabling unprecedented access to historical stereographic archives and facilitating their reintroduction to contemporary audiences through immersive technologies.

15:00 **Current Practices for Autochrome Digitization,** *Yoko Arteaga, Irina-Mihaela Ciortan, and Giorgio Trumpy, Norwegian University of Science and Technology (Norway); and Catlin Langford, Victoria & Albert Museum (UK)* **203**
Autochromes, invented by the Lumière Brothers in 1907, consist of a glass plate, photographic emulsion, and a colour filter made of dyed potato starch granules and carbon. Due to the autochrome's fragile nature and susceptibility to fading and damage, many institutions limit the plates' exposure to light and movement. This highlights the importance of high-quality digitisation to ensure wider public access and preservation. Currently, there are no specific guidelines for digitising autochromes. To address this, a survey was conducted to understand current practices around autochrome digitisation. Additionally, imaging tests were performed to evaluate different methods and provide guidelines. The survey results and experimental findings will inform standardised digitisation approaches.

15:15 **Closing remarks**

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