

2nd International Conference on Visual Pattern Extraction and Recognition for Cultural Heritage Understanding (VIPERC 2023)

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Abstract

This document presents the 2nd International Conference on Visual Pattern Extraction and Recognition for Cultural Heritage Understanding (VIPERC 2023), a premier forum for presenting the state-of-the-art, new research, ongoing work, academic and project reports in advanced statistics and machine learning, 3D modelling and simulation, knowledge representation, intelligent systems, information retrieval and software engineering, for visual pattern extraction, analysis and recognition to preserve the cultural heritage.

Keywords

Cultural heritage, Artificial Intelligence, Pattern recognition, Modelling and simulation.

1. Introduction

All of the material and immaterial facets of historical, archaeological, architectural, and creative significance are connected to cultural heritage. Every piece of cultural heritage conveys the myths and customs of individuals, families, groups, and nations all across the world. Cultural heritage is a priceless way for society to trace its roots and use the past to shape the present. It is seen in everything from contemporary natural sceneries and artwork to the ruins of historic sites. It is an important aspect of daily existence.

Ancient structures, archeological sites, monuments, sculptures, paintings, coins, submerged ruins and towns, shipwrecks, manuscripts, photos, videos, and other objects with artistic, archaeological, architectural, and historical significance are examples of tangible cultural heritage. On the contrary, ancient buildings' acoustic heritage, customary crafts and festivals, oral traditions and expressions, dialects and sub-dialects, music, culinary traditions, and lifestyles can all be gathered as intangible objects.

In order to analyze and explore hidden features, new hypotheses, relationships, trends, and modes from the data of cultural heritage, it is first necessary to extract, recognize, and model

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visual patterns. This is the main process of knowledge discovery and representation from cultural heritage. Anything that can be perceived by the human senses is considered a visual pattern.

Today partly, the extraction, recognition and modelling of visual patterns have been accomplished using simulation models, artificial intelligence, software computing, information retrieval and statistical analysis in multiple real-life contexts and scenarios.

From all aforementioned, the 2nd International Conference on Visual Pattern Extraction and Recognition for Cultural Heritage Understanding (VIPERC 2023) welcomed contributions from different research areas such as Image Processing, Artificial Intelligence, Software Engineering, Data Mining and Knowledge Discovery, and Modelling and Simulation, for visual pattern extraction, analysis and recognition to preserve the cultural heritage. More specifically, VIPERC 2023 accepted original and survey research contributions in advanced statistics and machine learning, 3D modelling and simulation, knowledge representation, intelligent systems, information retrieval and software engineering. Additionally, it was suggested as a stimulating environment for industrial partners who wished to showcase, characterize, and encourage innovation in goods and services as well as highlight their benefits from an economic and social perspective as well as from a scientific and technological one in the area of cultural heritage.

VIPERC 2023 was part of the research activity of the Italian National Research Project: "GENESIS - Sismic risk management for the tourist enhancement of the historic centers of Southern Italy", PON funds R&I 2014-2020 and FSC.

Finally, VIPERC 2023 was officially supported and endorsed by the Technical Committee on Automation in Logistics of the IEEE Robotics & Automation Society.

2. Topics

Topics of interest included, but were not limited to:

- Machine learning and data science for cultural heritage multimedia data
- Discrete geometry techniques for pattern recognition in cultural heritage images
- Combinatorial pattern matching and discovery in ancient images
- Graph-based methods for cultural heritage multimedia data
- Signal processing in the cultural heritage
- Intelligent systems for art restoration
- Augmented and virtual reality systems
- 3D reconstruction and model processing
- 3D modelling and simulation of cultural heritage items
- Classification or clustering of acoustic data from the cultural heritage
- Image processing, texture and shape analysis in historical data
- Computer vision for pattern extraction from cultural heritage images
- Remote sensing for cultural heritage preservation
- Data Mining for historical language recognition
- Image similarity and segmentation for the cultural heritage
- Deep learning applied to cultural heritage multimedia data

- Nature-inspired algorithms for historical multimedia data
- Natural Language Processing in the cultural heritage
- Knowledge representation and ontologies for ancient multimedia data
- Historical document processing and classification
- Speech, audio and music recognition and analysis from historical archives
- Archiving and searching methods for cultural heritage multimedia data
- Information retrieval in cultural heritage multimedia collections
- Discrimination and recognition of ancient languages and dialects
- Feature selection and extraction from cultural heritage multimedia data
- Ensemble methods for visual understanding of cultural heritage
- Industrial products, projects, prototypes and artefacts for cultural heritage preservation
- Explainable AI for the recognition of ancient multimedia data

3. Past VIPERC events

In the past, three VIPERC events were organized. Two of them were in the form of international workshop, and one of them was in the form of international virtual conference:

- The 1st International Workshop on Visual Pattern Extraction and Recognition for Cultural Heritage Understanding, that was held on 30 January 2019 in the CNR Area of Pisa, Pisa, Italy (VIPERC 2019¹),
- The 2nd International Workshop on Visual Pattern Extraction and Recognition for Cultural Heritage Understanding, that was held on 29 January 2020 at the University of Bari Aldo Moro, Bari, Italy (VIPERC 2020²).
- The 1st International Virtual Conference on Visual Pattern Extraction and Recognition for Cultural Heritage Understanding, that was held on 12 September 2022 (VIPERC 2022³).

Both VIPERC 2019 and VIPERC 2020 were in-site and co-located with the Italian Research Conference on Digital Libraries (IRCDL). Also, VIPERC 2022 was in virtual form and co-located with the 19th International Conference on Artificial Intelligence: Methodology, Systems, Applications (AIMSA 2022). The book of Proceedings of all three events is available in CEUR-WS (Volumes 2320, 2602, and 3266, respectively).

The attendance rate of VIPERC events in previous years made it possible to offer VIPERC 2022 and 2023 in the form of conference rather than workshop. In particular, VIPERC 2023 was organized as in-presence satellite conference of the 27th International Conference on Theory and Practice of Digital Libraries (TPDL 2023), and was held on 25-26 September 2023 in Zadar, Croatia.

¹https://ircdl2019.isti.cnr.it/?page_id=537

²<https://kdde.di.uniba.it/ircdl20/index.php/viperc-2020/>

³<https://sites.google.com/view/viperc-2022/>

4. Scientific Committee

The scientific relevance of the conference is assured by an international Organizing Committee which includes 23 researchers from 8 different countries worldwide (Italy, Romania, Serbia, Pakistan, Greece, Brazil, Bosnia and Herzegovina, Sweden), and an international Program Committee which includes 19 researchers from 9 different countries worldwide (Italy, France, Bulgaria, Finland, Romania, Macedonia, South Africa, Greece, Bosnia and Herzegovina).

All the members of the Scientific Committee are recognised as experts in cultural heritage, knowledge representation and information retrieval, algorithms, pattern recognition, artificial intelligence, modelling and simulation methods.

Honorary Chair:

- Radu Ionescu, Professor, University of Bucharest & CTO of SecurifAI, Romania.

General Chairs:

- Alessia Amelio, Senior Researcher, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy,
- Francesco Cauteruccio, Researcher, DII Marche Polytechnic University, Italy,
- Domenico Ursino, Full Professor, DII Marche Polytechnic University, Italy,
- Luca Virgili, Research Fellow, DII Marche Polytechnic University, Italy.

Program Chairs:

- Maria Giovanna Masciotta, Researcher, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy,
- Sergio Montelpare, Full Professor, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy,
- Valentino Sangiorgio, Researcher, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy.

Organization Chairs:

- Gianluca Bonifazi, Research Fellow, DII Marche Polytechnic University, Italy,
- Giuseppe Brando, Associate Professor, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy,
- Luciano Caroprese, Senior Researcher, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy.

Publications Chairs:

- Guido Camata, Associate Professor, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy,
- Camilla Lops, Research Fellow, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy,
- Enrico Spacone, Full Professor, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy.

Publicity Chairs:

- Enrico Corradini, Research Fellow, DII Marche Polytechnic University, Italy,
- Michele Marchetti, Research Fellow, DII Marche Polytechnic University, Italy,
- Alessandro Ricciutelli, Research Fellow, InGeo University "G. d'Annunzio" Chieti-Pescara, Italy.

International Relations Chairs:

- Nouman Ali, Associate Professor, Department of Software Engineering, Mirpur University of Science & Technology, Pakistan,
- Marijana Ćosović, Assistant Professor, Faculty of Electrical Engineering, University of East Sarajevo, Bosnia and Herzegovina,
- Anders Hast, Professor, Uppsala University, Sweden,
- Radmila Janković Babić, Research Assistant Professor, Mathematical Institute of the Serbian Academy of Sciences and Arts, Serbia,
- Katerina Kabassi, Professor and Vice Rector for Academic Affairs, International Relations and Extraversion, Department of Environment, Ionian University, Greece,
- Carlos Mello, Associate Professor, Center of Informatics, Federal University of Pernambuco, Brazil.

Program Committee:

- Cristina Cantagallo, University "G. d'Annunzio" Chieti-Pescara, Italy,
- Michelangelo Ceci, University of Bari Aldo Moro, Italy,
- Adrian-Gabriel Chifu, Aix-Marseille University, France,
- Claudia Diamantini, Marche Polytechnic University, Italy,
- Ivo Rumenov Draganov, Technical University of Sofia, Bulgaria,
- Ionut Cosmin Duta, Huawei, Finland,
- Stefano Ferilli, University of Bari Aldo Moro, Italy,
- Iuliana Georgescu, University of Bucharest, Romania,
- Branislav Gerazov, "Ss. Cyril and Methodius" University in Skopje, Macedonia,
- Dustin van der Haar, University of Johannesburg, South Africa,
- Giuseppe Manco, ICAR-CNR of Rende, Italy,
- Maura Mengoni, Marche Polytechnic University, Italy,
- Michail Panagopoulos, Ionian University, Greece,
- Maria Antonietta Pascali, ISTI-CNR of Pisa, Italy,
- Marius Popescu, University of Bucharest, Romania,
- Belma Ramić-Brkić, Sarajevo School of Science and Technology, Bosnia and Herzegovina,
- Marco Ricci, University of Calabria, Italy,
- Gian Piero Zarri, Sorbonne University, France,
- Ester Zumpano, University of Calabria, Italy.

5. Invited Speakers

VIPERC 2023 also included two invited talks.

The first one was by Dr. Marijana Tomić, Associate Professor, Head of the Department of Information Sciences, University of Zadar, Croatia, and Head of the scientific Centre for Research in Glagolitic, with title: "The application of digital methods and tools for the research of Glagolitic manuscripts and manuscript fragments: a case study of the Zadar GlagoLab portal and laboratory".

The second one was by Dr. Francesco Carlo Morabito, Full Professor in signal processing, Mediterranea University of Reggio Calabria, Italy⁴, with title: "Meta-Learning approaches to knowledge extraction from patterns in paintings".

5.1. Biographies

Dr. Marijana Tomić is Associate Professor, Head of the Department of Information Sciences at the University of Zadar, Croatia, and Head of the scientific Centre for Research in Glagolitic. Prof. Tomić's research interests include digital humanities, digital transformation of cultural heritage and GLAM institutions, manuscript studies, filigranology, fragmentology and bibliographic organization of information. She is a member of a number of scientific projects, including project Linguistic, paleographic and codicological analysis of fragments of the collection of Ivan Berčić of Zadar provenance in virtual research environment (IP.01.2021.22) and Protection of Zadar cultural heritage from the negative impact of microorganisms (IP-2021-01). Within an interdisciplinary scientific project Digitization, Bibliographic Description and Research of Texts Written on Glagolitic, Croatian Cyrillic and Latin Scripts Until the End Of 19th Century in Zadar and Šibenik Area (Written heritage) she started to implement digital methods and tools in the research of Croatian Glagolitic.

Dr. Francesco Carlo Morabito is Full Professor in signal processing at the Mediterranea University of Reggio Calabria, Italy. Prof. Morabito (Senior Member, IEEE) has authored or coauthored over 400 papers in international journals/conference proceedings in machine/deep learning, signal processing and computational intelligence. He has coauthored less than 20 international books (mostly focused on neural networks and machine learning) and held five international patents. He serves as a Governor of the International Neural Network Society (INNS), from 2022 to 2024, and earlier for 12 years, from 2000 to 2012. He has served as the President of the Italian Neural Network Society (SIREN), from 2008 to 2014. He is the Co-Chair of the Italian Conference on Neural Networks (WIRN).

6. Outcomes

VIPERC 2023 was held in the afternoon of 25 September 2023 from 3pm to 7pm (registration, welcome speeches and session 1) and in the morning of 26 September 2023 from 9am to 10:35am (session 2) - Croatian time - at the II Palaces (Multimedia Hall), Trg Petra Zoranića 1, 23000, Zadar, Croatia. Both sessions were also broadcast live and made available at the InGeo

⁴<http://neurolab.ing.unirc.it/>

Department Facebook page⁵ and Youtube channel⁶, after receiving the authorization from TPDL 2023 Conference Organizers. For each participant to VIPERC 2023, registration fee was set to 100 euros.

Two members of the VIPERC 2023 Organizing Committee, Dr. Alessia Amelio and Dr. Valentino Sangiorgio, were present to the event. On 25 September 2023 at 4pm (Croatian time), Prof. Marijana Tomić and Dr. Alessia Amelio, presented the welcome reception. It saw the exceptional participation of the Vice-Rector for Scientific Affairs and Information Infrastructure of the University of Zadar, Prof. Zvezdan Penezić, who made a welcome speech to VIPERC 2023 participants. Dr. Valentino Sangiorgio chaired the session 1 and presented the first invited talk by Prof. Marijana Tomić. Dr. Alessia Amelio chaired the session 2 and presented the second invited talk by Prof. Francesco Carlo Morabito.

The conference received 11 submissions. They were reviewed by a total of 19 international research scholars of the Program Committee from 9 different countries: Italy, France, Bulgaria, Finland, Romania, Macedonia, South Africa, Greece, Bosnia and Herzegovina. Each submission was reviewed by at least 2 research scholars. The reviewers for each paper were selected from different institutions than the authors' institutions. Also, the reviewers should not be involved in co-authorship with the paper's authors.

The peer reviewing process was performed using the EasyChair system. Each paper was evaluated according to: (i) clarity, (ii) relevance of the topic, (iii) adopted methodology. The only papers with at least 2 acceptance scores, and any reject score, were definitively accepted. In the end, a total of 5 full papers was established to be included in the book of Proceedings. The accepted papers were authored by 20 research scholars from 4 different countries: Pakistan, Italy, Romania, United Arab Emirates.

The Session 1 of the conference included 3 presentations in the field of deep learning, computer vision and digital forensic applied to the cultural heritage. Also, the Session 2 of the conference included 2 presentations in the field of artificial intelligence and natural language processing for the cultural heritage. Exceptionally, the Organizing Committee of VIPERC 2023 authorized the online presentation of two papers through the Microsoft Teams platform, due to objective last-minute difficulties of the authors to reach the conference location. At the end, VIPERC 2023 successfully hosted a total of 25 participants.

7. Program

- **25 September 2023** (3pm - 7pm Croatian time)
- (3pm - 4pm): Registration and Welcome coffee
- (4pm - 4:15pm): Welcome speeches
 - Prof. Marijana Tomić, Chair of the Department of Information Sciences, University of Zadar, Croatia
 - Dr. Alessia Amelio, General Chair of VIPERC 2023
- **Session 1.** Chair: Dr. Valentino Sangiorgio

⁵<https://www.facebook.com/InGeoUdA>

⁶<https://www.youtube.com/@dip.diingegneriaeologiain754>

- (4:15pm - 4:45pm): Invited talk - Prof. Marijana Tomić, University of Zadar. *The application of digital methods and tools for the research of Glagolitic manuscripts and manuscript fragments: a case study of the Zadar GlagoLab portal and laboratory*
 - (4:45pm - 5pm) + 5min Q&A: Petru Rebeja, Eduard Coman, Claudiu Marinescu and Dan Cristea. *Steps in building a transcription technology: deciphering the content of historical romanian documents*
 - (5:05pm - 5:20pm) + 5min Q&A: Regina Finocchiaro, Samuele Biondi and Franco Bontempi. *On the innovative forms of communication in forensic engineering: the italian contest*
 - (5:25pm -5:40pm) + 5min Q&A: Israr Rehman, Zulfiqar Ali, Zahoor Jan, Muhammad Rashid, Ali Abbas and Nadeem Tariq. *Deep learning empowered classification of augmented cultural heritage images* (online presentation)
 - (6:00pm - 6:30pm): Welcome drink
 - 7:00pm: City tour
- **26 September 2023** (9am - 10:35am Croatian time)
 - **Session 2.** Chair: Dr. Alessia Amelio
 - (9am - 9:30am): Invited talk - Prof. Francesco Carlo Morabito, Mediterranea University of Reggio Calabria. *Meta-Learning approaches to knowledge extraction from patterns in paintings*
 - (9:30am - 9:45am): Coffee break
 - (9:45am - 10am) + 5min Q&A: Giuseppe Fallacara, Maria Pia Fanti, Fabio Parisi, Nicola Parisi and Valentino Sangiorgio. *AI-driven image generation for enhancing design in digital fabrication: urban furnishings in historic city centres*
 - (10:05am - 10:20am) + 5min Q&A: Mohamed W. Fareed and Mohamed Amer. *People-centred natural language processing for cultural tourism market: a research agenda* (online presentation)
 - (10:25am - 10:35am): Closing of VIPERC 2023 and Farewell coffee

8. Acknowledgments

We would like to thank the Program Committee and all members of the Organizing Committee, reviewers, authors, and all the participants to VIPERC 2023 for their support and for attending the event. Special thanks goes to TPDL 2023 Organizing Committee represented by the General Chair, prof. Drahomira Cupar, for the warm hospitality and support in organizing VIPERC 2023 in Zadar, Croatia.