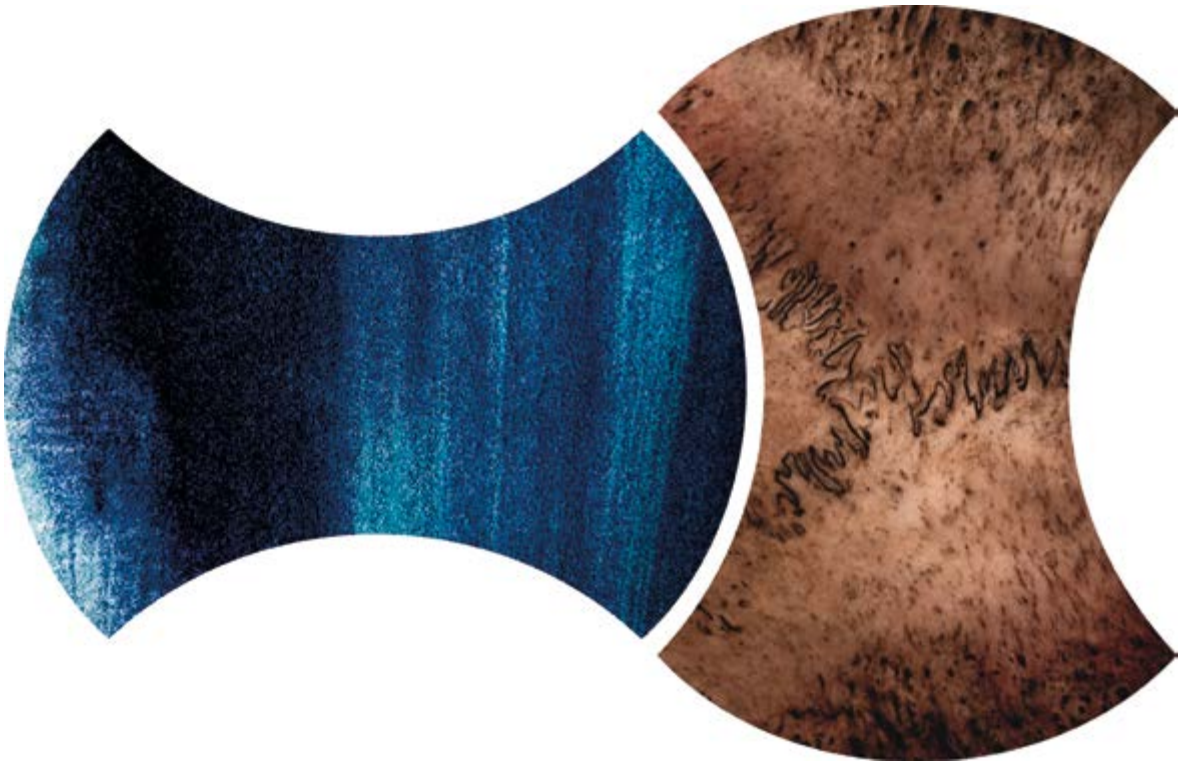
IACI
GRANADA
2024

Artificial Intelligence meets Craniofacial Identification



OCTOBER 2-6, 2024

20th Meeting of the International Association for Craniofacial Identification

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Welcome

from the Conference Organizing Committee

Welcome to the 20th edition of the International Association for Craniofacial Identification (IACI) meeting! We are thrilled to host this prestigious event for the first time in Spain. This year, we gather in the beautiful city of Granada, a place that stands as a beacon of innovation and cultural heritage.

Participants from all five continents have come together to share their knowledge and expertise in the field of craniofacial identification, with a special focus on the integration of artificial intelligence (AI) techniques. AI represents, at the same time, opportunities and threats in our field and our society. We believe the IACI community should face the AI challenges. Therefore, we have aimed to highlight the role of AI in craniofacial identification in the workshops, invited talks and oral and poster presentations of this edition. Your presence here is a testament to the global commitment to advancing our field, and we are honored to have such a diverse and distinguished group of professionals with us.

Granada is not only a hub for scientific and technological innovation but also a city of immense beauty and cultural richness. Nestled at the foot of the Sierra Nevada Mountains, Granada boasts a unique blend of Moorish and Spanish architecture, with the Alhambra palace as its crown jewel. Granada's multicultural heritage is reflected in its diverse population and the harmonious coexistence of different cultures and traditions. One of the highlights of Granada is its culinary scene, particularly the tradition of free tapas. Granada's tapas are a culinary journey in themselves. The city's lively atmosphere, combined with its delicious food, makes it a perfect place to unwind and connect with fellow participants after a day of insightful sessions.

As we embark on this journey of discovery and collaboration, we encourage you to actively participate in the discussions, workshops, and networking opportunities. Your contributions are invaluable to the success of this meeting and to the advancement of our field. We hope you take full advantage of the knowledge and experiences shared here, and that you leave with new insights and connections that will inspire your future work.

We invite you to not only engage with the scientific program but also to explore and enjoy the wonders of Granada. Let the city's charm and hospitality enhance your experience, making this conference a memorable and enriching event.

In the name of all the members of the IACI 2024 Organizing Committee, welcome once again, and let's make this 20th edition of the IACI meeting a resounding success!

Enjoy the meeting and the beautiful city of Granada.

Discover Granada

“Every city has its own charm, but Granada has its own and that of the rest.”

- Antonio Machado, Spanish Poet

A CROSS-ROADS OF CIVILIZATIONS

If there is a city that truly captures the essence of Spain, it is Granada. A cross-roads of civilizations for centuries and situated in an unparalleled location, Granada is a vibrant, friendly, and culturally rich metropolis. The Alhambra, the crown jewel of the city’s vast historical heritage, stands proudly atop a hill, overlooking a city that draws around three million visitors each year.

HISTORY OF GRANADA

Granada was once a kingdom and the capital of the last Muslim stronghold in Spain. It remained under Muslim rule for nearly eight centuries until it was conquered by the Catholic Monarchs on January 2, 1492, marking the end of Muslim rule in Spain. This historic year also saw the discovery of the Americas. The Catholic Monarchs held several meetings with Columbus in Granada, where they finalized a financial agreement and determined the number of ships and men required to cross the Atlantic, opening Spain to the New World.

Granada’s deep Muslim heritage is most evident in the Alhambra, a lasting symbol of this era. The city also boasts a rich Christian history, visible in emblematic buildings such as the Cathedral—the first Renaissance cathedral in Spain, known for its brightness and striking whiteness, commissioned by the Catholic Monarchs to symbolize the triumph of Christianity over Islam. The Royal Chapel, another landmark, houses the tombs of the Catholic Monarchs, who, enamored with Granada and seeing it as a symbol of their reign, chose to be buried in our city.

The Locations

UGR AI BUILDING

Workshops will take place here / 2-3 October

Av. del Conocimiento, 37,

18007 – Granada

FACULTY OF MEDICINE

Conferences will take place here / 4-5 October

Av. de la Ilustración, 1P

18016 – Granada

UNIVERSITY CAFETERIA PTS

Lunch breaks will take place here

Av. de la Ilustración, 4P

18016 – Granada

ABEN HUMEYA RESTAURANT

The IACI dinner will take place here / 5 October

Cta. de las Tomasas, 12, Albaicín

18010 – Granada

The Organizers

Panacea Cooperative Research specializes in research and development in the field of human identification, devising software tools to enhance the accuracy, efficiency, and objectivity of expert analysis. We address the complex challenge of identification, working to protect human rights and assist in the identification of missing persons, while providing full support to institutions and offering global training programs.

Our team includes anthropologists, AI experts, researchers, designers, and developers, all driven by a shared passion for AI innovation. As a spin-off of the University of Granada, we collaborate closely with academia, placing people at the heart of our cooperative approach to drive positive change.

UNIVERSIDAD DE GRANADA

The University of Granada (UGR) is a leading institution in education and research, with a history dating back to 1531. Renowned for its academic excellence and innovation, UGR offers a wide range of programs across various disciplines, fostering a dynamic environment for learning and discovery. The university is home to the Andalusian Research Institute in Data Science and Artificial Intelligence (DaSCI), a hub for cutting-edge AI research that tackles real-world challenges. UGR's Department of Anthropology is also recognized for its interdisciplinary approach, blending traditional studies with modern techniques to explore human culture and identity.

With a diverse community of students, researchers, and professionals, UGR is committed to fostering knowledge, creativity, and collaboration, making it a driving force in higher education and research.

Organizing Committee

Dr. Sergio Damas
University of Granada

Dra. Inmaculada Alemán
University of Granada

Dr. Óscar Ibañez
University of A Coruña

Dr. Rubén Martos
University of Granada

Rosario Guerra (MSc)
Panacea Cooperative
Research S.Coop.

Dr. Enrique Bermejo
Panacea Cooperative
Research S.Coop.

Congress Collaborators

PANACEA AND UGR ORGANIZATION

Noelia Fernández	Graphic Design and UX/UI
Inés Gómez	Management
Marta Hernández	Marketing and sales
Carolina Jiménez	Management
Marta Panizo	Web development

WORKSHOP INSTRUCTORS

Enrique Bermejo	Panacea Coop. Research
Mª Alejandra Guativonza	Panacea Coop. Research
Rosario Guerra	Panacea Coop. Research
Verónica Martínez	Panacea Coop. Research
Rubén Martos	University of Granada
Guillermo Ramírez	Panacea Coop. Research
Elena Ruiz	Policia Nacional de España
Carl Stephan	University of Queensland
Andrea Valsecchi	Panacea Coop. Research

CONGRESS ASSISTANTS

Antonio Barco	Panacea Coop. Research
Sebastian Kaiser	Panacea Coop. Research
Valentino Lugli	Panacea Coop. Research
Alejandro Manzanares	Panacea Coop. Research
Pilar Navarro	Panacea Coop. Research
Antonio D. Villegas	Panacea Coop. Research
Javier Venema	Panacea Coop. Research
Adela Boada	Panacea Coop. Research

2 DAYS OF WORKSHOPS

Program

WEDNESDAY **OCTOBER, 2**

09:00 - 13:00	**Workshop** THREE-DIMENSIONAL IMMERSION: 3D SCANNING WORKSHOP FOR CRANIOFACIAL IDENTIFICATION *with coffee break* UGR AI Building
	Workshop MACHINE LEARNING FOR PHYSICAL ANTHROPOLOGY: KEY CONCEPTS AND A PRACTICAL INTRODUCTION *with coffee break* UGR AI Building
13:30 - 15:00	**Lunch** University Cafeteria PTS
15:00 - 19:00	**Workshop** FORENSIC FACIAL COMPARISON USING ARTIFICIAL INTELLIGENCE *with coffee break* UGR AI Building

THURSDAY **OCTOBER, 3**

09:00 - 13:00	**Workshop** CRANIOFACIAL SUPERIMPOSITION USING SKELETON-ID *with coffee break* UGR AI Building
13:30 - 15:00	**Lunch** University Cafeteria PTS
15:30 - 17:30	**Workshop** INTRODUCTION TO THE POWER OF R AND BASIC R PROGRAMMING FOR NEWBIES *with coffee break* UGR AI Building
	Guided Lab Tour UGR AI Building Faculty of Medicine
18:00 - 21:00	Reception and registration **Welcome Cocktail** UGR AI Building

WORKSHOPS

TITLE Three-Dimensional Immersion: 3D Scanning Workshop for Craniofacial Identification

EXPERTS Ruben Martos (Ph.D.), Enrique Bermejo (Ph.D.), Guillermo Ramírez (M.Sc.), Verónica Martínez (M.Sc.), Rosario Guerra (M.Sc.) and Mª Alejandra Guativonza (M.Sc.)

WORKSHOP DESCRIPTION

Welcome to the 3D scanning workshop for craniofacial identification! In this educational event, we will explore two fundamental approaches to three-dimensional capture of bone elements: 3D scanning using structured light scanners and photogrammetry.

OBJECTIVES

Provide a comprehensive overview of how these technologies revolutionize three-dimensional analysis in the fields of forensic anthropology and craniofacial identification

Objective 1: Understand the Fundamentals of 3D Scanning with Structured Light

a) Explore the basics of 3D scanning with structured light, identifying its inherent advantages and disadvantages

b) Analyze closely the features and technical specifications of equipment such as Artec Space Spider, Leo, Eva, and Micro used in 3D scanning

c) Address the specific application of 3D scanning with structured light in craniofacial superimposition, highlighting use cases and practical examples

d) Enhance understanding through live demonstrations of the 3D scanning process and the subsequent processing of captured elements with Artec Studio software

Objective 2: Explore the Principles of Photogrammetry Applied to Craniofacial Superimposition and Facial Comparison

a) Break down the fundamental concepts of photogrammetry, evaluating its advantages and disadvantages compared to other 3D scanning approaches

b) Immerse in the features and technical specifications of hardware, highlighting equipment such as Dimensional Imaging DID4, Photorobot, and homemade photogrammetry systems

c) Demonstrate the scanning of skulls and jaws using the Photorobot system, with a specific focus on craniofacial superimposition

d) Provide basic notions of the workflow for processing captured data using software such as Metashape and Meshroom

e) Explore the application of facial scanning in facial comparison using the DID4 system from Dimensional Imaging

PROGRAM OUTLINE

In the first section, we will delve into the basics of 3D scanning with structured light, highlighting the advantages and disadvantages inherent in this method. We will closely analyze the features and technical specifications of hardware, including equipment such as Artec Space Spider, Leo, Eva, and Micro. Additionally, we will address its specific application for craniofacial superimposition. The experience will be enriched with live demonstrations of the 3D scanning process and the subsequent processing of captured elements using Artec Studio software, showcasing examples such as skulls, jaws, teeth, etc. In the second part of the workshop, we will explore the fascinating world of photogrammetry. We will break down the fundamental concepts of this approach, evaluating its advantages and disadvantages. We will immerse ourselves in the features and technical specifications of hardware, highlighting equipment such as Dimensional Imaging DID4, Photorobot, or homemade photogrammetry systems. With a specific focus on craniofacial superimposition, we will demonstrate the scanning of skulls and jaws using the Photorobot system. Basic notions of the workflow for processing captured data using software such as Metashape or Meshroom will be provided. The workshop will culminate in the exploration of facial scanning for its application in facial comparison using the DID4 system from Dimensional Imaging.

WORKSHOPS

TITLE Machine Learning for Physical Anthropology: key concepts and a practical introduction

EXPERTS Andrea Valsecchi (Ph.D.)

WORKSHOP DESCRIPTION

Machine Learning (ML) studies the development of computer algorithms that can learn to solve a problem from examples. While ML is at the heart of most modern Artificial Intelligence technologies, its adoption in Physical Anthropology is still quite limited. This workshop will enable you to address this situation. First, by overcoming the technological barrier, through a gentle introduction to friendly ML software. Second, by providing a solid understanding of the key concept of ML, which allows you to avoid the most common mistakes in the design of experiments and the interpretation of their results.

OBJECTIVES

- Understand the basics of Machine Learning and its potential in Anthropology
- Learning the key concepts in designing an experimental study
- Put the theory into practice with real-world applications

RESOURCES

- Sample/Synthetic datasets of forensic data for different applications
- TBD: Virtual machine/docker with code editor and python and libraries OR

PROGRAM OUTLINE

1. Introduction to Machine Learning
   - Common tasks: classification and regression
   - Understanding models
   - Model complexity and overfitting
2. Designing experiments
   - Training and testing, cross-validation
   - Comparing results
   - Practical and statistical significance
3. Practical Exercises using Python and sklearn

WORKSHOPS

TITLE Forensic Facial Comparison using Artificial Intelligence

EXPERTS Enrique Bermejo (Ph.D.), Mª Alejandra Guativonza (M.Sc.) and Elena Ruiz (M.Sc.)

WORKSHOP DESCRIPTION

Unlock the future of forensic investigation at our cutting-edge workshop, where the realms of Forensic Facial Comparison and Artificial Intelligence converge. This unique session is designed for professionals and enthusiasts alike, offering an immersive exploration into the dynamic synergy between facial forensics and the latest advancements in AI technology.

OBJECTIVES

- Gain a comprehensive understanding of the principles of forensic facial comparison
- Understand the challenges and potential biases associated with AI-driven facial comparison and learn strategies to address them
- Acquire a fundamental knowledge of Artificial Intelligence and its transformative impact on forensic science

PROGRAM OUTLINE

1. Introduction to Forensic Facial Comparison:
   - Understanding the principles of facial recognition in forensic investigations
   - Exploring the standard facial comparison techniques
   - Analyzing practical recommendations from international working groups
2. AI in Forensic Science: A Paradigm Shift:
   - Delving into the transformative impact of Artificial Intelligence on forensic practices
   - Exploring the latest innovations and 3D technologies shaping the future of facial analysis in forensic science
   - Interactive session with 3D scenarios to understand the relevance of the camera model
3. Emerging Technologies in Forensic Facial Analysis:
   - Filtering candidates with AI-based photo-anthropometry
   - Understanding the capabilities of 3D/2D facial superimposition
   - Unpacking the statistical foundations of facial variability to describe facial morphology
   - Live Demos and Practical exercises:
   - Interactive sessions with state-of-the-art tools powered by AI
   - Hands-on exercises to enhance participants' practical skills in forensic facial comparison

Join us at this workshop to gain invaluable insights, enhance your skill set, and be at the forefront of the intersection between Forensic Facial Comparison and Artificial Intelligence.

WORKSHOPS

TITLE Craniofacial Superimposition using Skeleton-ID

EXPERTS Rosario Guerra (M.Sc.),Mª Alejandra Guativonza (M.Sc.) Rubén Martos (Ph.D.) and Andrea Valsecchi (Ph.D.)

WORKSHOP DESCRIPTION

Attendees will learn the basic concepts and foundations of Craniofacial Superimposition, as well as its relevance as a skeleton-based identification technique, form a basic concept of the camera parameters involved in the process of taking a photograph and understand a novel approach to Craniofacial Superimposition as a camera calibration problem.

OBJECTIVES

This workshop will cover the fundamentals of Craniofacial Superimposition (CFS), from the origins of the technique to state of the art in AI-driven approaches, while providing the participants with an overview of its reliability, strengths and weaknesses, and the most recent validation studies carried out.

It will combine lectures followed by hands-on using the first dedicated software, Skeleton-ID, which includes AI-based methods to automate the majority of the CFS stages. In particular, we will learn how to locate craniofacial landmarks on a skull 3D model and cephalometric landmarks on a photograph,as well as to perform 3D-2D skull-face overlays. During the hands-on, attendees will learn how to evaluate similarities and discrepancies in craniofacial morphological and anatomical features as well as the key criteria to evaluate the correspondence between a skull and a facial image, including dental features. They will also become familiar with current standards and best practices in this technique, proposed by the MEPROCS consortium, as part of the speakers were key members of this international group.

PROGRAM OUTLINE

1. Presentation:
   - Introduction to the workshop and speakers
   - Results of the survey
   - Learning objectives and schedule

2. Introduction to Craniofacial Superimposition:
   - Foundations of the technique
   - Soft tissue depth studies
   - Landmark vs morphological analysis approaches
   - Craniofacial relationships – introduction
   - History and technological development
   - Photo CFS, Video CFS, computer aided CFS
   - The MEPROCS consortium

3. Hands-on:
   - Introduction to dedicated CFS software – navigation and tools
   - Placing cephalometric landmarks on a photograph
   - Placing craniometric landmarks on a skull 3D model
   - Skull-Face Overlay as a camera calibration problem
   - Photograph parameters: camera rotation, focal length, subject-camera distance, principal point
   - Automatic SFO: camera calibration, pairs of landmarks, soft tissue depth studies
   - Skull-Face Overlay exercises
   - Evaluation of the Skull-Face Overlay and decision-making
   - Craniofacial anatomical relationships
   - Analysis of morphological correspondences
   - Evaluation of criteria and decision making
   - Reaching a final identification decision and generating a report

WORKSHOPS

TITLE Introduction to the Power of R and Basic R programming for Newbies

EXPERTS Carl N. Stephan (Ph.D.)

WORKSHOP DESCRIPTION

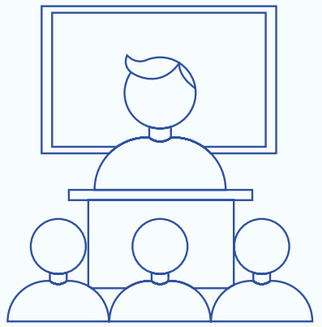
In this workshop, AP Stephan will introduce delegates to the programming environment of R (and its power!) at a basic level and within just 2hrs so that upon leaving the workshop participants have the tools to begin programming their own basic projects. Delegates will be walked through the basic steps of R and R programming that are enabling for data analysis, in hands on sessions – so bringing your own laptop with base-R preinstalled is a must and don't be surprised that you will be in control of telling R what to do following Carl's lead. The emphasis will be on R as a data processing and programming environment, not just a statistical tool for running statistical tests. If you want to learn some programming or R, but have stalled or not yet taken the plunge, this workshop is for you! After whetting your appetite with some basic functions/commands and seeing how much you can achieve in a short time with only a few lines of code, you will be craving for more! Only your brain will be the limit of what you can do with R!.

OBJECTIVES

- Gain a basic appreciation for the extensibility of R
- Learn some basic R to get started with your own programming
- Learn basic GUIs, file importing and exporting in R
- Learn some basic data handling in R and automation

2 DAYS OF PRESENTATIONS

SPEAKERS
SPEAKERS
SPEAKERS



Pablo Mesejo

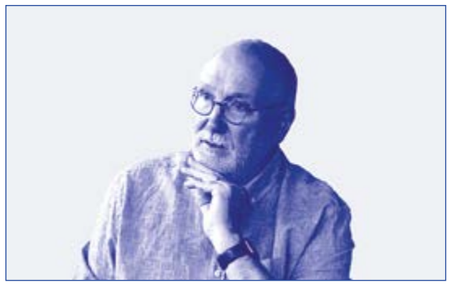
ABOUT

Pablo Mesejo is Associate Professor at the Department of Computer Science and Artificial Intelligence (DECSAI) of the University of Granada (UGR, Spain). The main topic of his research is the analysis and design of machine learning, computer vision and computational intelligence methods able to solve image analysis problems, mainly related to the biomedical domain. During his career he has tackled numerous challenging problems, e.g. the automatic segmentation of anatomical structures in biomedical images (PhD at University of Parma, Italy, performed as a Marie Curie Early Stage Researcher, 2010-13), the classification of gastrointestinal lesions from endoscopic videos (postdoc at University of Auvergne, France, in a research lab belonging to CNRS, 2013-14), the estimation of biophysical parameters from fMRI signals (postdoc at Inria, France, 2014-16), and the integration of deep learning into probabilistic generative models for visual and audio recognition in human-robot interaction (starting researcher position at Inria, 2016-18), among others. He joined the UGR in April 2018 as a Marie Curie Experienced Researcher (highly competitive research grants that presented a 13.10% success rate in the H2020-MSCA-IF-2016 call). His Marie Curie proposal Skeleton-ID, specifically dealt with the application of AI techniques to the comparison of radiographs in forensic human identification. He is co-founding partner and chief AI officer of Panacea Cooperative Research, vice-chair of the IEEE Computational Intelligence Society (CIS) Task Force on Evolutionary Computer Vision and Image Processing (chair from 2018 to 2021), member of the IEEE CIS Task Force on Evolutionary Deep Learning and Applications, Associate Member of the American Academy of Forensic Sciences (AAFS, Digital and Multimedia Sciences Section), and member of the Andalusian Research Institute on Data Science and Computational Intelligence (DaSCI).

Óscar Cordón

ABOUT

Oscar Cordón received his Ph.D. (1997) in Computer Science from the University of Granada, Spain, where he is a Professor (2011-) and was Founding Director of the Virtual Learning Center (2001-05) and Vice-President for Digital University (2015-2019). He was a founding researcher of the European Centre for Soft Computing (2006-2015). He was awarded with the IEEE CIS Outstanding Early Career Award (2011), the Spanish National Award on Computer Science ARITMEL (2014), the IEEE Fellow grade (2018), the IFSA Fellow (2019), the Recognition of the Spanish AI Association (AEPIA) for his Scientific Career and the Promotion of AI (2020), the IX ICT Spanish University of Universities (CRUE TIC) IT Professional Career Award (2022), and the Granada Ciudad de la Ciencia y la Innovaci n Award to Knowledge Transfer (2022), among other recognitions. He was a member of the High-Level Expert Group that elaborated the Spanish R&D Strategy on AI (2019). He has published >400 scientific publications (including 126 JCR-SCI-indexed journal papers), advised 22 Ph.D. dissertations, coordinated 41 research projects and contracts (with an overall amount of ~10M), and has a granted international patent under exploitation on an intelligent system for forensic identification. He is included in the 1% of most-cited researchers in the world (source: Web of Science) and in the Top 2% of the most cited researchers in the world in Artificial Intelligence (source: Ranking of the World Scientists: World’s Top 2% Scientists , University of Stanford-Elsevier).



Dirk Vandermeulen

ABOUT

Professor Dirk Vandermeulen holds the position of professor of medical and forensic image analysis at the Division for Image and Speech Processing, Department of Electrical Engineering, KU Leuven. He is also an extraordinary professor at the University of Pretoria, South Africa.

Initially, his research focused on image processing for computer-assisted stereotactic neurosurgery. Some of this work has been implemented in a commercially available stereotactic planning system. Later, his work shifted towards medical image analysis, still strongly emphasising neurosurgical and neurological applications. He now co-supervises research work on model-based image analysis and, more recently, deep learning.

Since 2002, Professor Vandermeulen has applied computer vision and medical image analysis techniques to forensic imaging, particularly craniofacial reconstruction, biometric authentication, and facial analysis. His major scientific achievements in forensic image analysis include co-developing craniofacial reconstruction methodologies and software, being the first to create a statistical-based reconstruction method. He also co-supervised the development of morphometric analysis tools for facial analysis and studied phenotype-genotype relationships. Additionally, he has co-supervised advanced computer vision and image analysis approaches in forensic image analysis, such as bloodstain pattern analysis and dental age estimation.

Professor Vandermeulen has a long list of publications, with over 120 journal papers and nearly 150 conference articles. According to Google Scholar, his h-index is 61, his i-10 index is 160, and his total number of citations is 24334.

Sergio Castro

ABOUT

Sergio Castro Martínez serves as an Inspector with the Spanish National Police, dedicated to the field of facial identification since 2008. In 2014, he assumed the role of Head of the Facial Identification Group at the Forensic Sciences Headquarters, subsequently becoming its Technical Director in 2015. His remarkable contributions extend to international projects, notably as a member of the Interpol Working Group since 2015, representing Spain.

Since 2015, Sergio has also played a pivotal role as a member of the Interpol Disaster Victim Identification (DVI) Working Group's Steering Committee. In this capacity, he has actively worked towards updating Interpol protocols for DVI, organizing the annual Interpol DVI conference, and fostering an international network for disaster victim identification.

Furthermore, his involvement in European initiatives is evident through his leadership role since 2018 as the ENFSI (DIWG) Facial Image Comparison Subgroup Leader, participating as steering committee member and coordinator to enhance collaboration within the European forensic community. Since 2022, he is also a member of the Europol EUCB Facial Image Comparison Core Group.

Sergio's dedication to advancing the field of forensic sciences, particularly in facial image comparison, reflects his commitment to international collaboration and the enhancement of protocols and practices to advance global standards in human identification.

Caroline Wilkinson

ABOUT

Caroline Wilkinson is Professor of Craniofacial Identification and Director of the Forensic Research Institute (FORRI) at Liverpool John Moores University. She is a chartered forensic anthropologist Level I (craniofacial specialism) by the Royal Anthropological Institute (RAI) and is an experienced forensic practitioner.

Caroline is currently Chair of the EU-funded COST Action for Migrant Disaster Victim Identification, a consortium created to enhance the identification of people who die trying to reach Europe from war torn or socioeconomically disrupted countries. These MDVI efforts received a Times Higher Education Award 2023 for Research Project of the Year; Arts, Humanities and Social Sciences.

Caroline is also Director of Face Lab, a research group within FORRI that carries out forensic/archaeological research and consultancy work including craniofacial analysis, facial depiction and forensic art. Craniofacial analysis involves the depiction and identification of unknown bodies for forensic investigation or historical figures for archaeological interpretation. Face Lab research relates to facial identification, craniofacial reconstruction, preserved bodies and facial animation.

Caroline is Fellow of the RAI, the Royal Society of Edinburgh (RSE), the Anatomical Society and the Royal Photographic Society. She received the 2016 Combined Royal Colleges Medal for excellence in clinical imaging and has appeared in multiple television series, including Meet the Ancestors (BBC), History Cold Case (BBC), Expert Witness (C4), Real crime (C5), Royal Institution Christmas Lectures 2022 (BBC) and Secrets of the Dead (PBS).

ABSTRACTS
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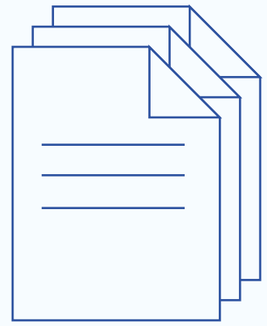

*Following the program order.

Program

FRIDAY **OCTOBER, 4**

08:00 - 09:00	**Open Registration** Faculty of Medicine
09:00 - 09:30	**Congress Opening** Faculty of Medicine
09:30 - 10:15	**Plenary Speakers** ÓSCAR CORDÓN AND PABLO MESEJO Faculty of Medicine
10:15 - 10:45	**Poster Session** *with coffee break*
10:45 - 11:45	**Oral Presentations I** **Ramphaleng, T. K., Hemingway, J., Houlton, T. and Briers, N. -** Clines of the African face **Buyukcakir, B., Claes, P.D., Vandermeulen, D. -** A Contrastive Analysis of Attention In Dental Staging With Deep Learning: A Case Study **Claessens, N. Walsh, S., Shriver, M., Weinberg, S.M., Cattaneo, P.M., Penington, A. J., Claes, P.D. -** A geometric deep learning model for synthetic aging and age estimation from 3D facial surface scans **Imaizumi, K., Usui, S., Hayakawa, H., Shiotani, S. and Nagata, T.-** Development of machine-learning based sex estimation methods for the skull and several regions of the skull Faculty of Medicine
11:45 - 13:00	**Oral Presentations II** **Healy, S., Stephan, C.N.-** Perspective distortion tolerances and skull-face registration in craniofacial superimposition **Martínez-García, V., Guativonza, M.A. , R-Garcia, G., Guerra, R., Villegas-Yeguas, A. D., Manzanares, A., Navarro, P.,, Valsecchi, A., Martinez, Moreno, P.,, Lugli, V. G. , Ibáñez, O. and Bermejo, E -**Craniofacial Superimposition using the Skeleton-ID software for Human Identification **Bermejo, E., Navarro, P., Lugli, V. , Manzanares, A. and Valsecchi, A.-** Subject-to-camera distance estimation in facial photographs using Deep Learning and Machine Learning Methods. **Valsecchi, A., Martinez, P., Navarro, P., Lugli, V., Guerra, R., Guativonza, M.A., Martínez, V., R-García, G., Ibáñez, Ó., Mesejo, P. and Damas, S. –** Advancements in Craniofacial Superimposition using Artificial Intelligence **R-García, G., Guerra, R., Valsecchi, A. and Ibáñez, Ó. -** Proposal for the use of intra-oral images for the identification of missing persons Faculty of Medicine
13:15 - 14:45	**Lunch** University Cafeteria PTS
14:45 - 16:00	**Oral Presentations III** **Stephan, C.N.-** Quality Literature Reviews Matter: A Case Study of 27 years of Misinformation in Forensic Facial Reconstruction and a New Path Forward (FFC) **Utsuno, H., Garry, M., Hanafi, S., Namiki,S., Aoki, N., Uemura, Y., Yamada, S., Saitoh H., Minegishi, S., Makino Y., Iwase, H. and Sakurada, K. -** The observation of the ear morphology for facial reconstruction (approximation) **Maclennan, M., Houlton, T.R.M. and Gomez Garcia-Donas, J -** For the Love of Good: Resurrecting the Lost Face Behind Damien Hirst's 'For the Love of God' Diamond-Encrusted Human Skull **Li, Y. –** From Skulls to Faces: A Deep Generative Framework for Realistic 3D Craniofacial Reconstruction Faculty of Medicine
16:00 - 16:30	**Poster Session** *with coffee break*
16:30 - 17:15	**Oral Presentations IV** **Hona, T.W.P.T. and Stephan, C.N. -** Covariation of Facial Soft Tissue Thicknesses with Body Mass and Body Mass Index: Which one Yields Stronger Correlations? **Navarro-López B.1,2,3, Suárez-Ulloa V.4, Wilke F.5, Baeta M.1,2,3, Martos-Fernández R.6, Olalde I.1,2,7, Martínez-Jarreta B.8, Jiménez S.9, Walsh S.5 and de Pancorbo M.M.-** From DNA to nose shape: integrating anthropological methods and quasi-landmark mesh analysis. **Guerra, R., Guativonza, M.A.,Martínez-García, V., R-García, G., Ibáñez, Ó., Valsecchi, A., Bermejo, E., Manzanares, A., Villegas, A.D., Navarro, F., and Alemán, I. -** Diving into new depths: Unveiling the positional relationship variation of hard and soft tissue across demographics Faculty of Medicine
17:15 - 18:00	**Plenary Speaker** DIRK VANDERMEULEN Faculty of Medicine
18:00 - 19:00	**IACI Biannual General Meeting** Faculty of Medicine

PLENARY SPEAKERS

AUTHORS Mesejo, P. [1,2], Cordón, O. [1]

AFILIATIONS [1] Andalusian Research Institute in Data Science and Computational Intelligence, University of Granada, Granada, Spain / [2] Department of Computer Science and Artificial Intelligence, University of Granada, Granada, Spain

TITLE Artificial Intelligence meets Craniofacial Identification: applications, challenges and future trends

ABSTRACT

Artificial Intelligence (AI) is the science and engineering of creating machines that solve tasks in such a way that, if a human being solved them that way, he/she would be said to be intelligent. It is a broad field of knowledge that includes, without any claim of exhaustivity, machine learning, computer vision, natural language processing and automated planning, among others, and whose usefulness and applicability in numerous areas is well-known (from self-driving cars to biomedical diagnosis, from domestic cleaning to the development of humanoid robots for social interaction). In this talk we will focus on the application of certain AI techniques to forensic human identification and, mainly, craniofacial identification. We will see how AI technologies as fuzzy sets and systems, evolutionary computation, deep learning and computer vision can contribute to the automation of forensic identification by means of cranio-facial superposition ranging from automatically locating cephalometric landmarks and obtaining the skull-face overlay to estimating soft tissue thickness and subject-to-camera distance, as well as providing support in the whole forensic decision making process. We will also focus on comparative radiography where deep learning can help in the automatic and accurate segmentation of radiographs, and evolutionary image registration can develop the automatic superimposition between the ante-mortem and post-mortem segmented structures in an automatic fashion. In addition, we will also introduce some deep learning applications to the analysis of 3D bone models, or even simulate age progression in facial images. We will end the talk with a presentation of the main challenges, limitations and opportunities that AI offers in the forensic field.

ORAL PRESENTATIONS I

AUTHORS Ramphaleng, T. K.[1], Hemingway, J., Houlton, T.[2], and Briers, N.[3]

AFILIATIONS [1] Human Variation and Identification Research Unit (HVIRU), School of Anatomical Sciences, University of the Witwatersrand, Johannesburg. / [2] Centre for Anatomy and Human Identification, School of Science and Engineering, University of Dundee, Dow Street, Dundee, DD1 5EH, UK. / [3] Division of Clinical Anatomy, Faculty of Medicine and Health Sciences, University of Stellenbosch, Tygerberg.

TITLE Clines of the African face

ABSTRACT

Africa experiences high levels of migration between different continents and countries. This migration comprises both documented and undocumented people. Undocumented migration creates undue pressure on medico-legal mortuary facilities due to additional challenges that arise in the event of death. Focusing on the African context, this research aimed to determine clinal changes of the African face in regional parts of the continent to support unidentified decedent forensic inquiries. The University of the Witwatersrand Raymond A. Dart Face mask collection was used to sample 551 masks of African descent. Photogrammetric scans of the masks were taken in 3D and craniofacial landmarks placed on the face. To determine geographic differences of the African face, a MANOVA test was used. The clinal variation was tested using discriminant function analysis. For the geographically distant population approximation, a permutation test was used. To illustrate the facial morphology changes with geography a partial least square test was performed. Tests indicate that the African face of four regions of the continent namely northern, southern, eastern, western, are distinct. A representation of geographically specific facial morphology of African populations is related to clines on the continent. These regional variations in facial morphology could potentially provide critical assistance when pursuing forensic inquiries across the continent.

KEYWORDS

Facial morphology / Living Face / Deceased Face / Face / The African Population

AUTHORS Buyukcakir, B.[1], Claes, P.D.[1] and Vandermeulen, D.[1]

AFILIATIONS [1] ESAT, Center for Processing Speech and Images, KU Leuven, Leuven, Belgium

TITLE A Contrastive Analysis of Attention In Dental Staging With Deep Learning: A Case Study

FUNDING

This work was funded by KU Leuven under grant number: 3E180439.

ABSTRACT

Dental age assessment, as a field of forensic odontology, plays a crucial role in identification applications. It is conventionally performed by well-trained experts on panoramic radiographs to classify individual teeth into developmental stages. Deep learning is the state-of-the-art in the automation of this process. However, when applying deep learning models to high-stakes scenarios, such as forensic investigations, understanding the model's behaviour is critical. A common approach to such explainability investigation are visual attention maps, though these maps can also fail to reveal the underlying problems. Thus, we present a case study on inspecting the performance disparity in the application of the same deep model on radiographs of two different molars. We evaluate a deep neural network-based system that provides additional transparency, on top of the conventional approach of attention maps, which helps to understand information representation and model performance. A vision transformer (ViT) neural network model is used as a baseline, due to the high performance and the inherent attention mechanism of the architecture. This baseline is compared to our proposed framework, consisting of a triplet autoencoder with for representation learning and a ViT for classification and attention map generation. We use this framework on FDI teeth #37 and #38 dental staging datasets to explain the staging performance disparity. Our framework achieves 0.72 classification accuracy on tooth #37, and 0.39 on tooth #38, while revealing the data-centric issues for tooth #38. The framework with the autoencoder also highlights the problem of low inter-stage separability in the tooth #38 dataset, offering increased transparency and interpretability by providing access to a latent space, where further analysis is carried out by image reconstructions. We thus aim to provide an alternative approach to explainability in the field of forensic odontology.

KEYWORDS

Deep Learning / Visual Attention / Dental Staging / Forensics / Vision Transformer

AUTHORS Claessens, N.[1], Walsh, S.[2], Shriver, M.[4], Weinberg, S.M.[4], Cattaneo, P.M.[5], Penington, A. J.[6,7,8], Claes, P.D.[1,9]

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TITLE A geometric deep learning model for synthetic aging and age estimation from 3D facial surface scans

ABSTRACT

Facial imaging has emerged as a key tool for estimating age and predicting growth, both of which are central to a variety of forensic domains, including missing children's cases and disaster victim identification. Even though 3D images have recently become more widely available, existing craniofacial growth studies tend to utilize 2D images over their information rich 3D counterparts. Meanwhile, current 3D studies are typically based on linear models or sparse landmarks, leaving many discriminative aspects of the face unexplored. Here, we implement a conditional variational autoencoder to estimate age and predict growth in children and adults. In addition to modeling growth nonlinearly, variational autoencoders allow infinite shape sampling by forcing the latent space to adopt a normal distribution. Our dataset, sourced from four different centers, consists of 5204 3D surface scans of individuals aged 0-88 years, including follow-up images from 60 individuals 5-6 years later. Using MeshMonk, we obtained 7160 dense quasi-landmarks for each image, providing a detailed representation of facial shape. Importantly, our network utilizes spiral convolutional layers, which can efficiently extract features from 3D meshes. After encoding, the extracted features are merged with the age label embeddings before transitioning to the latent representation, resulting in an age-independent latent space. Prior to decoding, the latent sample is combined with the desired age's embeddings to predict the subject's appearance at a new age. On top of predicting an individual's facial shape at any given age this also allows us to generate any number of faces from a certain age. Age estimation is achieved by minimizing the reconstruction error relative to the age label. We evaluated the accuracy of our growth predictions using real aged faces from the longitudinal data. Our findings demonstrate that geometric deep learning presents a promising approach for modeling craniofacial growth on 3D surface scans.

KEYWORDS

3D Modeling / Synthetic Aging / Age Estimation / Deep Learning

ORAL PRESENTATIONS I

AUTHORS Imaizumi, K.[1], Usui, S.[1], Hayakawa, H.[2], Shiotani, S.[3] and Nagata, T.[4]

AFILIATIONS [1] National Research Institute of Police Science / [2] Tsukuba Medical Examiner's Office/ [3] Seirei Fuji Hospital / [4] Meiji Gakuin University

TITLE Development of machine-learning based sex estimation methods for the skull and several regions of the skull

ABSTRACT

Sex estimation from the skull plays an important role in the identification of skeletal remains. We developed sex estimation method from three-dimensional shapes of the skull and several regions of the skull using machine learning technology.

A total of 240 (120 males, 120 females) skull shapes were obtained from post-mortem computed tomography data. The shapes of the whole skull, the cranium only, and the mandible only were first wrapped with virtual film to simplify the shapes using an in-house software. Homologous models of them were created with MeshMonk toolbox and the homologous segments of the superciliary arch, the zygomatic region, the parietal region, the occipital region, the mastoid process, and the inferior border of the mandible were prepared from the models of the cranium and the mandible. The coordinates of vertices of the models were reduced in dimensionality by principal component analysis (PCA) and partial least squares regression (PLS). Known sexes and the scores of the obtained components were supplied to the support vector machine with radial basis function kernel, and the accuracy rates of sex estimation were obtained by a 10-fold double-looped cross-validation procedure.

By reducing dimensionality with PLS, higher accuracy rates were obtained in the sex estimation compared to that with PCA. The rates reached to 93% in the whole skull, the cranium, the superciliary arch, and the zygomatic region. The poorest rate (82%) was found in the parietal region. Virtual shapes created from very large and small scores of the first components of PLS showed the clear sexual dimorphisms that have been proposed by many researchers.

The sex estimation method developed here enables us to perform objective identification of skeletal remains required in forensic anthropology field.

KEYWORDS

Sex Estimation / Machine Learning / Forensic Anthropology / Skeletal Remains

ORAL PRESENTATIONS II

AUTHORS Healy, S.[1] and Stephan, C.N.[1]

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TITLE Perspective distortion tolerances and skull-face registration in craniofacial superimposition

ABSTRACT

Craniofacial superimposition requires the overlay of a postmortem skull image and an antemortem face image so the anatomical concordance of the two can be assessed. When the exact photographical variables of the antemortem photograph is exactly replicated when recording the skull, including position, location and image scale, this the superimposition is a straightforward task, as the images are directly comparable. In practice, however, these photographical variables, and in particular focus distance, are not exactly replicated as focus distance of the antemortem face image is rarely known. This does not invalidate the technique, rather it raises the question as to what degree of differences can be tolerated, and what image registration methods should be used. Recently a ±1% mismatch in facial height was posited as an acceptable upper tolerance limit when considering perspective changes caused by focus distance, however, this proposition is speculative and has not been confirmed in real-life tests. Additionally, the effects of different skull-face registration methods have received little consideration. Examination of real-world photographs, as well as synthetic images generated using matching 3D face and skull models from a single computed tomography scan were used to evaluate the previously posited ±1% tolerance and different image registration methods. These tests suggested that a ±1% tolerance is sufficient for craniofacial superimposition, and the image registration should be based on the single sellion/nasion point combination to minimize anatomical misalignment of anatomy in the principal region of interest, the mid-face.

KEYWORDS

Craniofacial Superimposition / Perspective Distortion / Focus Distance

ORAL PRESENTATIONS II

AUTHORS Martínez-García, V.[1,2], Guativonza, M.A.[4,2] , R-Garcia, G.[1,2], Guerra, R.[1,2], Villegas-Yeguas, A. D.[1,5], Manzanares, A.[1], Navarro, P.[1], Valsecchi, A.[1,3], Martinez Moreno, P.[3,5], Lugli, V. G.[1], Ibáñez, O.[1,3,4] and Bermejo, E.[1,3]

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TITLE Craniofacial Superimposition using the Skeleton-ID software for Human Identification

ABSTRACT

Craniofacial Superimposition (CFS), as a method of Human Identification, is of utmost importance in a wide range of situations, such as Disaster Victim Identification (DVI) cases (67,500 deaths/year), migrants (+3,000 arrivals/year at EU borders, more than 23,000 currently unidentified victims) and armed conflicts (+2 million unidentified deceased worldwide). This technique is based on the study of the individualizing anatomical relationship between the skull and the face and can be used to establish identification, especially in cases where it is not possible to use conventional methods such as the comparison of fingerprints or DNA samples.

This work shows the use of SKELETON-ID as a tool to guide the semi-automatic application of the CFS technique and its application to real scenarios, in which the experts compared several facial photographs to the 3D model of the dubitated skulls to try to assess the candidate's identity.

The automatic craniometric and cephalometric landmark location algorithm was used to perform these comparisons, the POSEST-SFO algorithm was used to perform the overlays, and the MEPROCS scale was used to support the decision making process. The positive results shown in this communication highlight the usefulness of this software for forensic experts and the relevance of adequate training in the technique.

KEYWORDS

Human Identification / Craniofacial Identificacion / Forensic Anthropology / Artificial Intelligence

ORAL PRESENTATIONS II

AUTHORS Bermejo, E.[1,2], Navarro, P.[1], Lugli, V.[1] , Manzanares, A.[1] and Valsecchi, A.[1,2]

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TITLE Subject-to-camera distance estimation in facial photographs using Deep Learning and Machine Learning Methods

FINANCIAL SUPPORT

This work was supported in part by MCIN/AEI/10.13039/501100011033 and ERDF "A way of making Europe" under Grant CONFIA PID2021-122916NB-I00. Additionally, E.B's work has been funded by MCIN/AEI/10.13039/501100011033 under grant PTQ2022-012457.

ABSTRACT

For human identification techniques involving the comparison of photographs, it is important to take into account all the factors that may affect the appearance of the subject, such as head pose, illumination, facial expression, image resolution, etc. In addition, anatomical features can change considerably depending on the distance between the camera and the subject being photographed, leading to what is known as perspective distortion. It is not reliable to compare two photographs with different degrees of perspective distortion, a condition that can be detected through the estimation of the subject-to-camera distance (SCD) of the two photographs. While a few SCD estimation methods exist, they are limited in terms of precision or applicability to many photographic scenarios.

In this work, we present a novel approach for the estimation of SCD using machine learning (ML). In particular, a series of ML models have been trained to predict the SCD of a photograph based on dimension and proportionality indices (DPIs), calculated from facial landmarks placed on the face of the subject. A large database of synthetic photographs have been created by taking simulated pictures of 3D facial models with a wide variety of photographic conditions. The results are promising, prompting an in-depth analysis of the performance of the method and its limitations in comparison to existing methods within the current state of the art.

KEYWORDS

Subject-to-camera Distance / DPI / Machine Learning / Photography / Perspective Distortion.

ORAL PRESENTATIONS II

AUTHORS Valsecchi, A.[2,5], Martinez, P.[4,5], Navarro, P[2]., Lugli, V.[2], Guerra, R.[1,2], Guativonza, M.A.[2,3], Martínez, V.[1,2], R-García, G.[2], Ibáñez, Ó.[2,3], Mesejo, P.[4,5] and Damas, S.[4,6]

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TITLE Advancements in Craniofacial Superimposition using Artificial Intelligence

FINANCIAL SUPPORT

This work was supported in part by MCIN/AEI/10.13039/501100011033 and ERDF "A way of making Europe" under Grant CONFIA PID2021-122916NB-I00. Praxedes Martinez is supported under FORAGE (B-TIC-456-UGR20) funded by the Spanish Consejeria de Universidad, Investigacion e Innovacion, both funded by "ERDF A way of making Europe". Rosario Guerra is supported by the Spanish Ministry of Science, Innovation and Universities, and the State Research Agency (AEI), under grant "Doctorandos Industriales" (DIN2020-011619), including European NextGenerationEU funds. Dr. Ibañez's work is funded by Spanish Ministry of Science, Innovation and Universities under grant RYC2020-029454-I.

ABSTRACT

Craniofacial Superimposition (CFS) involves three stages. First, the acquisition and processing of skull and facial images, possibly followed by the localization of anatomical landmarks. Second, the creation of a skull-face overlay (SFO), where the objective is to achieve the best possible projection of the skull onto the AM facial image(s). Third, the decision-making stage, where the analyst assesses whether the skull belongs to the person in the photograph(s) or not.

Over the last decade, using techniques in Computer Vision and Artificial Intelligence, researchers developed computer algorithms able to perform the skull-face overlay automatically. These approaches focus on superimposing matching anatomical landmarks from the face and the skull while estimating the amount of facial soft tissue. The information provided to the algorithm is far from a complete representation of facial anatomy. Besides, the position of the anatomical landmarks can be subjective and the estimation of the soft tissue lacks specificity.

The aim of this study is to improve the automatic SFO process by providing additional information to the method. Beyond the location of the landmarks, we include a statistical model of the facial soft-tissue, together with information about the photograph (focal distance, subject-to-camera distance and overall facial pose). Moreover, the algorithm uses the shape and positional relationship of the chin, while the overall profile of the skull is matched to that of the face.

The experimental study involved a large database of simulated photographs, obtained from a sample of CT scans of 27 subjects. From each scan we obtained a 3D model of the skull and we also simulated 10 frontal photographs and 10 lateral photographs, for a total of 540 images. Each photograph has been superimposed with all 27 skulls, for a total of 14580 skull-face overlays. The results point to a clear improvement over the current state of the art in terms of accuracy and robustness thanks to the additional information involved in the process.

ORAL PRESENTATIONS II

AUTHORS R-García, G.[1], Guerra, R.[1,2], Valsecchi, A.[2,3] and Ibáñez, Ó.[3,4]

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TITLE Proposal for the use of intra-oral images for the identification of missing persons

ABSTRACT

The acquisition of three-dimensional models of intraoral images is an increasingly common practice when obtaining PM records. These models, together with AM photographic records, offer the possibility of bringing a new approach to dental comparison, allowing 2D-3D comparisons of teeth and exploiting the identifying power of these. For this purpose, a pilot study with a reduced sample is proposed in which these AM-PM records will be compared.

The main objective of this work is to develop new methods to exploit the full potential that intraoral scans can offer, proposing 2 approaches to study this feasibility; the first one consists of creating a set of landmarks involving the front teeth, marking both the three-dimensional model and a photograph. The second is based on the projection of the intraoral models onto the photograph, marking the occlusal contours of the upper teeth on both the photograph and the three-dimensional model and checking the similarity between the two (Masked DICE).

The results obtained in this preliminary study indicated that the contour-based approach provided the best results, with differences in Masked DICE values between positive and negative cases more than double in the worst case. In addition, from the set of landmarks created, the one with the highest discriminant power was the one with the most features of the central incisors, correctly cataloguing the positive cases and, again, with a difference in mean error >1 between positive and negative cases.

These results open the door to continue with this approach, hoping to apply it to a larger study to corroborate the efficacy of both methods.

KEYWORDS

Human Identification/ Forensic Dentistry / Intra-Oral Scans

ORAL PRESENTATIONS III

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TITLE Quality Literature Reviews Matter: A Case Study of 27 years of Misinformation in Forensic Facial Reconstruction and a New Path Forward

ABSTRACT

A literature review is one of the first and most-basic precursors to developing any new piece of published scientific or scholarly work. But what happens when the literature review goes awry for decades? Here such an intriguing case in forensic facial reconstruction with regards to method classes, first seeded and then perpetuated by linguistic biases, is described. Starting in 1997, a single case of published misinformation activates a 27-year cascade of further botched reviews (produced by different authors). Each review adds misplaced weight to the preceding one, eventually establishing discipline mistruths as 'facts'. The challenge now exists to correct the engrained misinformation, as especially applicable to facial approximation where new approaches and techniques are emerging and require sound foundations for forthcoming advances. The recent and ongoing citation of the errors in the facial reconstruction domain, as recently as last year, and yet again after the last debunking almost a decade ago, highlights the adverse and long-lasting impacts major literature review mishaps can carry. This paper reviews the pros and cons to previously published misinformation concerning the "Russian", "American" and "Combination" method classes, and the multiple lessons this case study holds for scholarly safeguards within craniofacial identification at all levels, including: authorship, peer-review and editorial-review. The review underscores two critical factors: 1) investigators should strive to identify and consult primary literature sources to conduct quality literature reviews; and 2) linguistic biases should be avoided at all costs. Common threads that run through all methods should be celebrated in terms of the pre-existing scientific standardization that they provide, in contrast to any imagined differences that delineate various "schools" of thought.

KEYWORDS

Literature Review / Bias / Multilingual / Facial Reconstruction / Facial Approximation / Forensic Science / Peer-review

ORAL PRESENTATIONS III

AUTHORS Utsuno, H.[1], Garry, M., Hanafi, S.[1], Namiki, S.[1], Aoki, N.[1], Uemura, Y.[2,3], Yamada, S.[1], Saitoh H.[1], , Minegishi, S.[1], Makino Y.[2,3], Iwase, H.[2,3] and Sakurada, K.[1]

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TITLE The observation of the ear morphology for facial reconstruction (approximation)

ABSTRACT

Aim: As with the eyeball, nose, and lips, predicting the shape of the ear is important for facial reconstruction. Several methods have been proposed for this purpose. However, Guyomarc'h reported less accuracy than the previous methods. The ears exhibit various complicated morphological features. In this study, we report on ear morphology, aimed at establishing a method for ear prediction. In prosthetic dentistry, Snow (1900) reported that the condyle possess a 1/2 inch (12.5 mm) anterior to the anterior margin of the external acoustic meatus (EAM)/(tragus) on the Camper plane (inferior margin of the EAM to anterior nasal spine).

Methods: We measured the distances and analyzed the relationship between the condylar head (kdl), external acoustic meatus (po), and tragus (prt) in X (lateral), Y (anterior to posterior), and Z (superior to inferior) dimensions using Postmortem computed tomography (PMCT) images. We obtained 130 PMCT images (male:93, female:37) from a Japanese population. Statistical differences (sex, laterality, etc.) were analyzed using the t-test.

Result: In the analysis of sex differences, significant differences ($p < 0.01$) were observed between the left side of the prt and kdl in the X, Y, and Z dimensions. Differences in laterality were not observed except for the distance between prt and kdl in the female Y dimension ($p < 0.05$).

Discussion: In contrast to the authors' previous report on nose position (alar position), the position of the tragus showed minimal differences in laterality. The tragus is almost symmetrical between the left and right temporal bones. Based on these results, we aim to establish a comprehensive method for predicting the shape of the entire ear from the presented region.

KEYWORDS

Forensic Anthropology / Facial Reconstruction / Ear morphology / Ear Prediction

AUTHORS Maclennan, M.[1], Houlton, T.R.M.[2] and Gomez Garcia-Donas, J.[2]

AFILIATIONS [1] Edinburgh College of Art (ECA), The University of Edinburgh / [2] Centre for Anatomy and Human Identification (CAHID), The University of Dundee

TITLE For the Love of Good: Resurrecting the Lost Face Behind Damien Hirst's "For the Love of God" Diamond-Encrusted Human Skull

ABSTRACT

Almost twenty years ago, Turner Prize-winning artist Damien Hirst created 'For the Love of God': a platinum-cast human skull set with more than 8,000 diamonds. To this day, the skull is widely considered one of the most expensive pieces of contemporary art ever produced by a living artist, and is the largest diamond commission since the British Royal Family Crown Jewels.

Through the lens of 2D craniofacial approximation, 'For the Love of Good' seeks to stand in deliberate contrast with these themes; whereby (forensic, not-for-profit, humanitarian) art is instead utilized to conceptually explore and directly confront the increasing commodification and mistreatment of human remains in the production of (high-profile, costly, indulgent) art-for-profit.

In reconstructing the long-lost face behind the skull; the project seeks to raise awareness and encourage dialogue amongst both scientific and artistic communities surrounding the contemporary bone and blood diamond trade(s), whereby the legal acquisition and true provenance of material culture, diamonds, and human remains often goes unquestioned or undetected; where humanity and morality are often compromised in favour of power, money, fame, or status; and where plagiarism, exploitation, and colonialism erase consent, culture, and identity.

KEYWORDS

Craniofacial Reconstruction / Bone Trades / Blood Diamonds

AUTHORS Li, Y.[1]

AFILIATIONS [1] Department of Forensic Pathology, West China School of Preclinical and Forensic Medicine, Sichuan University

TITLE From Skulls to Faces: A Deep Generative Framework for Realistic 3D Craniofacial Reconstruction

ABSTRACT

The shape of the human face is largely determined by the underlying skull morphology. Craniofacial reconstruction (CfR), or the process of reconstructing the face from the skull, is a challenging task with applications in forensic science, criminal investigation, and archaeology. Traditional craniofacial reconstruction methods suffer from subjective interpretation and simple low-dimensional learning approaches, resulting in low reconstruction accuracy and realism. In this paper, we present a deep learning-based framework for CfR based on conditional generative adversarial networks. Unlike conventional methods that adopt 3D representations directly, we employ 2D depth maps to represent faces and skulls as the model's input and output. It can provide enough face geometric information and may mitigate the potential risk of dimensionality issues. Our framework is capable of modeling both local and global details of facial appearance through a novel discriminator structure that leverages multi-receptive field features in one output, thus generating realistic and individualized faces from skulls. Furthermore, to explore the impact of conditional information such as age and gender on facial appearance, we develop a conditional CfR paradigm that incorporates an improved residual block structure with conditional information modulation and a conditional information reconstruction loss function. Extensive experiments and comparisons are conducted to demonstrated the effectiveness and superiority of our method for CfR.

KEYWORDS

Craniofacial Reconstruction / Generative Adversarial Networks / Depth Map

AUTHORS Hona, T.W.P.T.[1] and Stephan, C.N.[1]

AFILIATIONS [1]Laboratory for Human Craniofacial and Skeletal Identification (HuCS-ID Lab), School of Biomedical Sciences, The University of Queensland, Australia

TITLE Covariation of Facial Soft Tissue Thicknesses with Body Mass and Body Mass Index: Which one Yields Stronger Correlations?

ABSTRACT

The influence of body size on facial soft tissue thicknesses (FSTTs) is widely recognised in the craniofacial identification literature. In recent years, body size has most commonly been described via body mass index (BMI). Although BMI is an important clinical measure of health, it may not be the most appropriate measure of body size when investigating the facial soft tissues in contrast to other similar measurements. This study aimed to evaluate the raw and relative relationships between FSTTs and different body size variables (BMI, height, and body mass) to determine which of the aforenoted body size variables is the most informative.

Facial soft tissue thicknesses were recorded from a new sample of Australian adults (n1=24) using magnetic resonance imaging. Body size measurements were also recorded. Five other independent samples sourced from the C-Table were additionally included to boost sample sizes, these comprised: American Whites (n2=100) and American Blacks (n3=60) (Manhein 2000), and Australians (n4=52, n5=71) (Preisler 2016; Stephan 2018) measured by B-mode ultrasound; and Turkish individuals (n6=50) (Bulut 2014) measured by computed tomography. Pearson Product Moment Correlation Coefficients (r) between FSTTs and each body size variable was calculated. Normalisation by body size was also performed to facilitate raw and scaled sex comparisons. Data analysis was performed in IBM SPSS® (v28) and Microsoft Excel® 2013.

Body mass exhibited stronger correlations with FSTTs than BMI at most FSTT landmarks (r range = 0.14–0.5; $p<0.05$), while correlations between height and FSTTs were generally weak. Compared to raw mean differences (F<M, by 7%), females displayed thicker FSTTs than males when normalized for body mass (F>M, by 14%).

Body mass, independent to BMI, yields strong correlations with FSTTs and facilitates relative adjustment of FSTTs to body scale to enable comparisons between individuals accounting for body mass as a confounding variable. Future studies should utilize body mass as a measure of body size.

KEYWORDS

Body Size / Body Scale / Correlation Coefficient

ORAL PRESENTATIONS IV

AUTHORS Navarro-López B.[1,2,3], Suárez-Ulloa V.[4], Wilke F.[5], Baeta M.[1,2,3], Martos-Fernández R.[6], Olalde I.[1,2,7], Martínez-Jarreta B.[8], Jiménez S.[9], Walsh S.[5] and de Pancorbo M.M.[1,8]

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TITLE From DNA to nose shape: integrating anthropological methods and quasi-landmark mesh analysis.

ABSTRACT

Genetic identification relies on the comparison of an individual's genetic data with reference profiles stored in forensic databases or from known individuals. However, cases where there is no genetic match often remain unresolved. In these situations, advances in Forensic DNA Phenotyping, which aims to predict externally visible characteristics (EVCs) from the DNA, could aid in individual identification. Among all EVCs, facial shape stands out as particularly informative. The present study has selected a set of previously published candidate SNPs and evaluated their correlation with facial phenotype in a Spanish population, focusing on the nose as studies have indicated that for facial recognition, the first two places the eyes focus on are around the nasal region. We utilized two different approaches on a collection of 412 individuals. First, a set of four cephalometric landmarks (alare, nasion, pronasale and subnasale) were used to estimate four linear measurements (nose width, nasal bridge length, nose height, and nasal tip protrusion) and two proportionality indices (nasal index and nasal bridge index), used in physical anthropology. Second, a spatially dense mesh of the nasal area was used to analyze nose shape over 1669 quasi-landmarks. Results revealed significant associations between several SNPs and different nasal metrics. Interestingly, SNPs and their associated facial areas identified in both strategies differed. These findings underline the importance of methodology in facial prediction when conducting genetic studies, especially, when considering forensic applications.

KEYWORDS

Forensic DNA Phenotyping / Nose Morphology / Candidate SNPs / Spanish Population

ORAL PRESENTATIONS IV

AUTHORS Guerra, R.[1,2], Guativonza, M.A.[1,3], Martínez-García, V.[1,2], R-García, G.[2], Ibáñez, Ó.[2,3,4], Valsecchi, A.[2,4], Bermejo, E.[2,4], Manzanares, A.[2], Villegas, A.D.[2,5], Navarro, F.[1], and Alemán, I.[1]

AFILIATIONS [1] Physical Anthropology Lab, Department of Legal Medicine, Toxicology and Physical Anthropology, University of Granada, Granada, Spain / [2] Panacea Cooperative Research S. Coop., Ponferrada, Spain / [3] Faculty of Computer Science, CITIC, University of A Coruña, La Coruña, Spain / [4] Andalusian Research Institute in Data Science and Computational Intelligence, University of Granada, Granada, Spain / [5] Department of Computer Science and Artificial Intelligence, University of Granada, Granada, Spain

TITLE Diving into new depths: Unveiling the positional relationship variation of hard and soft tissue across demographics

ABSTRACT

Soft tissue variation plays a crucial role in forensic Craniofacial Identification techniques, yet the spatial relationship between cranial landmarks and their facial counterparts remains understudied. Here, we present a novel methodology developed to address this gap, enabling the analysis of spatial variability across diverse populations, sexes, ages, and BMI groups.

We conducted a comprehensive analysis using Cone Beam Computed Tomography (CBCT) data from Korean and South African individuals, encompassing 100 subjects from each population aged between 20 and 60 years. Our semiautomatic approach enabled to carry out the segmentation of facial and cranial three-dimensional images and the initial location of landmarks, followed by a manual refinement of both cephalometric and craniometric landmarks. We extracted coordinates to analyze the positional relationship and variation between cranial and facial landmark pairs.

Statistical distributions of depth and direction vectors were computed for each landmark pair, shedding light on the thickness and positional relationship of soft tissue relative to underlying bone structures. Notably, our analysis reveals significant variations influenced by factors such as population affinity, BMI, age, and sex.

The implications of our findings extend to forensic techniques such as Craniofacial Superimposition and Facial Approximation, offering a novel framework to enhance their reliability. By elucidating the intricate relationship between cranial and facial soft tissue, our study paves the way for more accurate and robust forensic identification methodologies and opens the doors to the development of unforeseen possibilities in the world of CI, such as the quantification of PMI changes.

KEYWORDS

Facial Soft Tissue Thickness / Craniofacial Identification / Positional Relationship

PLENARY SPEAKER

AUTHORS Vandermeulen,D.[1]

AFILIATIONS KU Leuven

TITLE Computer Science meets Craniofacial Reconstruction

ABSTRACT

Computer science has made significant contributions to the field of craniofacial reconstruction, particularly in its application to forensic investigations. Forensic craniofacial reconstruction is the process of creating a facial approximation of an unidentified individual based on their skeletal remains. This process involves the use of advanced imaging techniques, such as CT and MRI, to create detailed 3D models of the skull and the face.

The utilisation of computational techniques has substantially facilitated forensic craniofacial reconstruction. By integrating statistical models that account for the correlation between skull and face, gender, and ethnicity, the resulting facial approximation can offer valuable insights to aid in the identification of an individual.

Overall, the use of computer science in forensic craniofacial reconstruction has assisted forensic investigators in identifying individuals based on their skeletal remains. This has important implications for law enforcement and justice systems, as it can help to solve cold cases and aid in the identification of missing persons.

This plenary talk will provide a comprehensive overview of the latest advances in computerised craniofacial reconstruction, making it an invaluable resource for professionals interested in this field. The presentation will feature a detailed analysis of the advantages and potential drawbacks of current techniques, including an exploration of any open problems that require attention. Moreover, the talk will examine the role of recent developments in AI technology and their potential impact on craniofacial reconstruction. Attendees will gain a deeper understanding of the state-of-the-art methods and insights into the future direction of this field.

Program

SATURDAY **OCTOBER, 5**

09:00 - 09:45	**Plenary Speakers** SERGIO CASTRO Faculty of Medicine
09:45 - 10:30	**Oral Presentations I** **Matine, N., Davimes, J.G., Billings, BK. and Bacci, N. -** Precision in Profiles: Investigating WFCS for forensic facial comparison in Black African male **Greenway, T.J., Wilkinson, C.M., Frowd, C.D. and Shrimpton, S. -** Enhancing the potential for recognition in forensic facial depictions through variation in texture, display and finishing effects **Guativonza, M.A., Lugli, V., Bermejo, E. and Ibáñez, O. –** Introducing FI4CI: a Facial Image database Faculty of Medicine
10:30 - 11:00	**Poster Session** *with coffee break*
11:00 - 11:45	**Oral Presentations II** **Burton, I., Wilkinson, C.M., Roberts, J. and Sudirman, S -** Post-mortem and ante-mortem 2D and 3D facial comparison for forensic identification **Urbanova, P., Goldmann, T. and Cerny, D. -** Poses and Grimaces: Challenges for automated face identification algorithms? **Bacci, N., Briers, N. and Steyn, M. -** Quantifying quality: Image quality effects on forensic facial comparison Faculty of Medicine
11:45 - 13:15	**Round Table** **Sergio Damas –** Prof. at University of Granada and Scientific Director of the Foundation "AI Granada, Research & Innovation" **Sergio Castro –** Police Officer at Spain's National Police and member of the Facial Identification Group at the National Headquarters. **Caroline Wilkinson –** Prof. of Craniofacial Identification and Director of the Forensic Research Institute (FORRI) at Liverpool John Moores University **Kazuhiko Imaizumi –**Second Forensic Biology Section, National Research Institute of Police Science (NRIPS), Japan **Desirée Davis –**Facial identification Team, Forensics Command, Australian Federal Police, Australia Faculty of Medicine
13:15 - 14:45	**Lunch** University Cafeteria PTS
14:45 - 15:30	**Plenary Speaker** CAROLINE WILKINSON Faculty of Medicine
15:30 - 16:00	**Poster Session** *with coffee break*
16:00 - 17:30	**Oral Presentations III** **Russ, H. -** The Norwegian NCIS and our work with facial recognition and biometrics. **Dickinson, R., Liu, C.Y.J., Parrott, E. and Roughley, M. -** Comparison of the external ear using different 3D surface scanning solutions for forensic application **Navarro, P., Lugli, V. and Valsecchi, A. -** Candidates filtering using photo-anthropometry and artificial intelligence under non-restrictive photographic conditions **Davis, D. -** AI vs the Australian Federal Police **Gomez-Trenado, G., Mesejo, P., Cordon, Ó., and Lathuilière, S. -** Custom Structure Preservation in Face Aging Faculty of Medicine
17:30 - 18:00	**Congress Closing**
18:00 - 19:00	**IACI Board of Governors Meeting** Faculty of Medicine
20:00 - 23:00	**IACI Dinner** Carmen de Aben Humeya Restaurant

PLENARY SPEAKER

AUTHORS Castro, S. [1]

AFILIATIONS [1]Spain's National Police

TITLE Automated Facial Recognition Tools in Forensics

ABSTRACT

Until now, facial identification in the forensic field was limited to 1:1 comparisons, in other words, a specific candidate was required to do the comparison. Consequently, the usefulness of this technique both in the police and the judicial field was limited to verifying whether the person appearing in certain images was the intended candidate.

From this year on, with the implementation of the new ABIS system module and its automatic Facial Recognition tool, it is now possible to search for candidates for given images. In short, investigation groups can count on a new tool to know the possible identity of the perpetrator of a criminal act seen in a given image.

During this presentation, we will go in-depth into the following topics:

- The main virtues and limitations of these tools
- The need for forensic experts as users of these systems as well as what qualities and training they should have
- How they react to different image qualities and variables
- How to deal with the results reporting process
- What are the biases of automatic facial recognition tools and how to minimize them?
- The main challenges in the implementation process of this type of tool

All this without losing focus on the international perspective, where important movements are also taking place in this field such as in the field of Interpol, Europol, EES, Eurodac, and others.

Finally, we will briefly describe the ACEV process followed by the expert to verify the 1:1 results in case this is required.

ORAL PRESENTATIONS I

AUTHORS Matine, N.[1], Davimes, JG.[1], Billings, BK.[1] and Bacci, N.[1]

AFILIATIONS [1] Human Variation and Identification Research Unit, School of Anatomical Sciences, Faculty of Health Sciences, University of the Witwatersrand, Johannesburg

TITLE Precision in Profiles: Investigating WFCS for forensic facial comparison in Black African male

ABSTRACT

Forensic facial comparison (FFC) is an established technique used for victim and perpetrator identification in medicolegal cases. At present, the Facial Identification Scientific Working Group (FISWG) descriptive feature list is the gold standard for FFC using morphological analysis. This list is however highly subjective and is purely descriptive in application. The current study aimed to introduce and evaluate the performance of the novel Wits Facial Classification Scheme (WFCS). The WFCS includes a semi-quantitative approach to FFC through the comprehensive classification and scoring of 412 facial traits coupled with stringent statistical testability.

The WFCS was applied to 100 face pools, including 1100 facial images across multiple views and of both wildtype and CCTV capture conditions from the Wits Face Database. The sample included males of African descent, aged 18-35. Facial trait scores were computed into average kappa agreement scores and composite facial comparison scores. Multiple statistical tests as well as ROC curves and confusion matrices were employed to assess performance.

Strong repeatability (95%) and reproducibility (73%) were observed for a single and second rater respectively, with overall better performance of the WFCS in wild type (WT) over CCTV images. Balanced accuracy was also higher in WT images for both average kappa agreement (92%) and composite facial comparison scores (76%), compared to CCTV (80% and 61% respectively). WFCS performance was higher when utilising average kappa agreement scores over composite scores. The FISWG feature list achieved higher accuracies in previous research, however, the concerns around its subjectivity and legal defensibility remain, hence investigating and improving more quantitative and testable FFC methods is crucial.

Overall, the novel WFCS achieved acceptable levels of reliability for FFC, however, further refinement and testing is required across diverse image capture conditions, populations, and gender to determine overall applicability in real world settings.

KEYWORDS

Forensic Facial Comparison / Morphological Analysis / Classification Scheme / CCTV and Reliability

ORAL PRESENTATIONS I

AUTHORS Greenway, E.C.J.[1], Wilkinson, C.M.[1], Frowd, C.D.[2] and Shrimpton, S.[1]

AFILIATIONS [1] Face Lab, Liverpool John Moores University / [2] University of Central Lancashire

TITLE Enhancing the potential for recognition in forensic facial depictions through variation in texture, display and finishing effects

ABSTRACT

Forensic facial depiction can facilitate the identification of unknown remains. By presenting an estimation of living facial appearance, the aim is to produce an investigative lead for law enforcement by sparking recognition from someone familiar with the individual. While research shows that the morphology of the face can be estimated to a good level of accuracy, textural information remains indeterminable from skeletal remains. Some suggestions for the addition of texture and display can be made, but the full parameters have not yet been realised. Through a series of face recognition experiments the different praxis for textural inclusion and display are assessed. The initial experiment in this series, tests current face presentation practice and builds a framework for the following experiments. Experiment 2 and 3 addresses dynamic versus static presentation and the benefit of including an additional viewpoint. Experiment 4 and 5 investigate the effect of background colour. Experiment 6 focuses on the creation of average texture, utilising the computer system Fantamorph, which is used to mimic the textural process of the composite face-building software, EvoFIT. EvoFIT very successfully hierarchically breeds facial texture to depict the faces of perpetrators from witness memory. Within Experiment 6, finishing effects are also tested, specifically the blurring of external features, increasing internal feature contrast and the incorporation of average 'ghost hair'. The results of these experiments will be framed as a protocol for textural inclusion and display in forensic facial depictions to maximise the potential for recognition.

KEYWORDS

Forensic Facial Depiction / Display Optimisation / Facial Texture / Face Recognition

ORAL PRESENTATIONS III

AUTHORS Guativonza, M.A.[2,3], Lugli, V.[2], Bermejo, E.[2,4] and Ibáñez, O.[2,3]

AFILIATIONS [1] Physical Anthropology Lab, Department of Legal Medicine, Toxicology and Physical Anthropology, University of Granada, Granada, Spain / [2] Panacea Cooperative Research S. Coop., Ponferrada, Spain / [3] Faculty of Computer Science, CITIC, University of A Coruña, 15071 La Coruña, Spain / [4] Andalusian Research Institute in Data Science and Computational Intelligence, University of Granada, Granada, Spain

TITLE Introducing FI4CI: a Facial Image database

ABSTRACT

Facial image (FI) databases provide very useful information in various research fields, specially in the medicolegal context of forensic facial comparison or facial recognition. However, conventional FI databases often face limitations, either by being too restricted in controlled environments or overwhelmed by an abundance of in-the-wild images.

Constrained databases have a specific aim and often lack the variability found in real-world situations or specific scenarios that can be used in facial comparison. Conversely, in-the-wild datasets, while reflective of real-world complexities, introduce noise and uncontrollable factors that can compromise accuracy.

We have proposed the creation of a novel facial image database that includes images in three modalities: photographs, videos, and 3D facial models, capturing a diverse range of facial images in various lighting conditions, facial expressions, and occlusion factors. The main purpose of the proposed database is to balance controlled and real-world situations, portraying realistic and complex scenarios suitable for the application of identification (ID) techniques based on facial images. The objective is not restricted to investigative practices but also to allow research focused on modelling diverse error sources, such as ageing factors, facial expressions, or perspective distortion.

We also present a protocol for facial image acquisition, with a detailed description aimed at facilitating its implementation. We introduce this proposal with the aim of sparking a collaboration between the IACI members in order to identify specific needs for the application of ID techniques based on FI, and also to encourage members to participate in expanding the dataset with data from different demographic characteristics. With this collaboration in mind, we also propose that part of this dataset can be available to the public for research purposes.

KEYWORDS

Forensic Facial Comparison / Facial Image / Photo-Anthropometry / Facial Superimposition.

AUTHORS Burton, I., Wilkinson, C.M.[1], Roberts, J.[2] and Sudirman, S.[3]

AFILIATIONS [1] Face Lab, Liverpool School of Art and Design, Faculty of Arts Professional and Social Studies, Liverpool John Moores University, Aquinas, Building, Maryland Street, Liverpool L1 9DE, United Kingdom / [2] School of Biological and Environmental Sciences, Faculty of Science, Liverpool John Moores University, James Parsons Building, Byrom Street, Liverpool L3 3AF, United Kingdom / [3] School of Computer Science and Mathematics, Faculty of Engineering and Technology, Liverpool John Moores University, James Parsons Building, Byrom Street, Liverpool L3 3AF, United Kingdom

TITLE Post-mortem and ante-mortem 2D and 3D facial comparison for forensic identification

ABSTRACT

This research explores the application of manual facial comparison methods and offline (semi-) automated face recognition algorithms to human identification of recently deceased individuals, using 3D (N=3) and 2D (N=6) data. Current methods are generally designed for and applied to the living, are not commonly used in combination or hierarchical order, and are mostly conducted under highly controlled, lab-based conditions. The aforementioned makes their applicability to real-life settings questionable at best, and research on their application to the deceased is scarce, although desperately needed. Further issues arise from the lack of uniformity and standardisation in methodological approaches, as well as feature descriptions and terminology.

This study investigates the applicability of combined, manual face comparison methods in hierarchical order (preliminary feature-based analysis, facial superimposition, detailed morphological comparison) and two (semi-) automated face recognition algorithms (MATLAB®; Google Picasa 5) to the recently deceased. Pilot and ancillary studies explore pretend-dead faces as a data source and evaluate geometry vs. texture in 3D face models.

Key findings indicate that human face matching ability is superior and more resilient to PM facial changes, non-standardised AM data, and limited data availability, compared to semi-automated methods tested. Results further suggest that a hierarchical approach to manual comparison is highly beneficial. The applied MATLAB® algorithm is unreliable even as a filtering tool and Picasa struggled to detect PM faces in images; an issue not encountered with pretend-dead data. Limitations arise primarily from the small sample size and non-quantifiable approaches to manual facial superimposition.

In forensic casework and DVI, comparative AM data for primary and even secondary methods of identification are often lacking. However, facial photographs are almost always attainable and should be considered an important resource for post-mortem identification. The interdisciplinary nature of this field requires collaborative efforts to address remaining challenges in the future.

KEYWORDS

2D 3D / Facial Comparison / Face Recognition / Morphological Feature Analysis / Superimposition

ORAL PRESENTATIONS II

AUTHORS Urbanova, P.[1], Goldmann, T. and Cerny, D.

AFILIATIONS [1] Department of Anthropology, Faculty of Science, Masaryk University

TITLE Poses and Grimaces: Challenges for automated face identification algorithms?

ABSTRACT

Forensic image identification is based on the assumption that images can convey identifying characteristics of individuals. While various physical attributes such as motion, body build, and clothing can be processed, facial appearance stands out as the most common identifying feature. In today's biometric and commercial settings, state-of-the-art image processing relies solely on artificial intelligence and machine learning, yet these principles are deeply rooted in abstract, complex "black-box systems". When applied to forensic image identification, concerns about transparency and accountability emerge.

This study explores the impact of two challenging factors in automated facial identification: facial expressions and head poses. The sample comprised 3D faces with nine prototype expressions, collected from 41 participants (13 males, 28 females) of European descent aged 19.96 to 50.89 years. Pre-processing involved converting 3D models to 2D color images (256×256 px). Probes included a set of 9 images per individual with head poses varying by 5° in both left-to-right (yaw) and up-and-down (pitch) directions for neutral expressions. A second set of 3,610 images per individual covered viewpoints in 5° increments from -45° to 45° for head movements and different facial expressions, forming the targets.

Pair-wise comparisons by two state-of-the-art face identification algorithms – ArcFace and MagFace, yielded 54,615,690 dissimilarity scores. Results indicate that minor head deviations in probes have minimal impact. Dissimilarity scores were consistently higher for males. For head poses, AUCs decreased as targets deviated from the frontal position. Right-to-left movements were less influential than up and down, with downward pitch showing less impact than upward movements. The lowest AUC (0.631) was for upward pitch at 45°. Female performance was consistently poorer for upward movements, starting at 15°, where ROC for females and males reached 0.875 and 0.988. Among tested facial expressions, happiness and contempt performed best, while disgust exhibited the lowest AUC values.

KEYWORDS

Forensic Image Identification / Automated Algorithms / Head Pose / Facial Expressions / Performance Rates

ORAL PRESENTATIONS II

AUTHORS Bacci, N.[1] Briers, N.[2], Steyn, M.[1]

AFILIATIONS [1] Human Variation and Identification Research Unit, School of Anatomical Sciences, University of the Witwatersrand, Johannesburg / [2] Division of Clinical Anatomy, Stellenbosch University

TITLE Quantifying quality: Image quality effects on forensic facial comparison

ABSTRACT

Forensic facial comparison by morphological analysis is considered the best practice approach to human-based facial identification yet is highly dependent on image quality. Limited research is available investigating image quality in a facial identification context. Hence, this study quantitatively assessed the impact of image quality on the ability of facial comparison in obtaining correct matches.

Image quality was assessed for target images of young African males from 400 morphological analysis-based facial comparisons conducted on the Wits Face Database dataset, across various conditions of capture (optimal photographs, typical CCTV, eye-level CCTV, and analogue CCTV). Firstly, an ordinal six-tiered image quality score was applied as an easy-to-use method to determine image quality. Additionally, face image resolution and quality of face lighting were investigated quantitatively through facial pixel proportions and monochrome histogram analysis.

The image quality scoring system was found effective at predicting accurate facial comparison match ability at higher quality scores and predicting incorrect match likelihood in poor quality images with an accuracy of 85.9% and a precision of 95.8%. Expectedly, higher face resolution proportions were associated with more true positives and true negatives. Conversely, darker images were associated to more false positive matches and brighter images with more false negatives matches.

The effectiveness of image scoring suggests that screening images prior to analysis using such a system can be used in practice to reduce false outcomes and wasting resources. The effect of low face resolution has been highlighted previously, but quantified for the first time; however, the opposite effect was expected with lighting. The effect of lighting may be dependent on skin complexion of the faces compared.

Investigating the effect of lighting in different populations is thus important. Further research on additional factors and across more varied image conditions may reveal clear quantitative thresholds for quality assurance of facial comparison images.

KEYWORDS

Forensic Facial Comparison / Morphological Analysis / Image Quality / Resolution / Lighting

PLENARY SPEAKER

AUTHORS Wilkinson, C. M. [1]

AFILIATIONS [1] Face Lab, Liverpool John Moores University

TITLE The use of craniofacial analysis in the identification of migrant disaster victims

ABSTRACT

Illegal immigration is a global challenge and economic migration is a critical issue for many European countries. Where migrants travel great distances, a large percentage reach the end of their lives attempting to cross bodies of water and inhospitable land masses between origin and destination.

The United Nations Refugee Agency estimates that more than 28,000 people have died making Mediterranean crossings alone since 2014. The true scale of the problem appears greater than this with reporting over the last 25 years varying from 19,000 to 53,000, according to the 2019 International Committee of the Red Cross report. Many identification experts are deeply troubled by the stark difference between the extensive, systematic, and efficient efforts by European countries/organisations to identify victims of armed conflict or humanitarian/natural disasters, and the lack of effort that is made to identify migrant disaster victims.

In 2023, an EU-funded COST Action was established for migrant disaster victim identification (MDVI), and this network aims to enhance identification efforts, influence international policy and improve MDVI capability, capacity and resilience across Europe. Secondary identifiers, such as craniofacial analysis have proved effective in MDVI situations where DNA, dental and fingerprint analysis are not possible due to a lack of access to antemortem data from families of the missing migrants. This paper describes recent research around craniofacial analysis for MDVI and discusses the challenges and opportunities associated with these applications.

ORAL PRESENTATIONS III

AUTHORS Russ, H.[1]

AFILIATIONS [1] National Criminal Investigation Service, Norway

TITLE The Norwegian NCIS and our work with facial recognition and biometrics

ABSTRACT

Facial comparison is a relatively new forensic science in Norway. Our department within NCIS. Norway was founded in 2016, and has grown exponentially to include over 30 employees in the following years. We currently employ forensic practitioners doing both 10-print finger examinations and facial comparisons using our automated computer system as well as manual 1:1 forensic facial examinations. We recently also merged with the department for forensic handwriting examination and are aiming to be able to offer a variety of biometric analysis to the Norwegian police in the future.

I would like to show how our examiners both work as experts in 1:1, 1: N and with CCTV pictures. Some of us also work with fingerprints, and in the future, we have the option of working with forensic handwriting as well. This gives an interesting diversity and synergy effect in our workforce. We are following the present standards given by FISWG and ENFSI and our facial analysis method has recently been awarded the highly prestigious ISO accreditation.

We support the Norwegian police, The Norwegian Directorate of Immigration, international police (Interpol) and we are expert line of the Norwegian Passport and ID office.

- Progress from the start in 2016

- How we are organized and who we are

- What are the benefits of having examiners doing both facial recognition and 1:1

KEYWORDS

Facial Comparison / Facial Recognition

ORAL PRESENTATIONS I

AUTHORS Dickinson, T.[1], Liu, C.Y.J.[1], Parrott, E.[1], Roughley, M.[1]

AFILIATIONS [1] Face Lab, Liverpool John Moores University

TITLE Comparison of the external ear using different 3D surface scanning solutions for forensic application

ABSTRACT

The digitisation of forensic evidence in three-Dimension (3D) is becoming a common tool for documentation and comparison purposes, the 3D model of an ear has the potential to improve 2D photograph comparison by eliminating pose variation.

This study explores different surface scanning solutions and compares 3D models of ear (n=17) from Photogrammetry (DSLR + Agisoft Metashape), and iOS applications (Metascan, Polycam, Scaniverse), to the professional scanning solution (Artec Space Spider).

Point clouds with 0.001 spacing were produced for all scans in Agisoft Metashape and imported into CloudCompare, an opensource software. The software allowed for cropping of the ear and landmark point picking to manually align the scans to the reference. Cloud to cloud comparisons were run to identify the distribution of points for each modality compared to Artec. The histograms produced showed the distribution of points across 100 classes within 1.5mm deviation from the Artec reference, with each class representing a distance of 0.015mm.

Result suggests both photogrammetry models (Agisoft DSLR: 68.7%; Metascan: 69.9%) were more similar to the Artec modality when compared to the iOS LiDAR models (Polycam: 47.0% and Scaniverse 60.3%). This suggests iOS LiDAR is not suitable for scanning small objects, and there is a variability between different applications. Accuracy of 3D models should be tested for any forensic use, this study informs forensic practitioners/police on the effectiveness, affordances, and the methodology to assess the accuracy of 3D imaging techniques.

KEYWORDS

Ear / 3D Scanning / Point Cloud

ORAL PRESENTATIONS III

AUTHORS Navarro, P.[1], Lugli, V.[1] and Valsecchi, A.[1],[2]

AFILIATIONS [1] Panacea Cooperative Research S. Coop., Ponferrada, Spain / [2] Andalusian Research Institute in Data Science and Computational Intelligence, University of Granada, Granada, Spain

TITLE Candidates filtering using photo-anthropometry and artificial intelligence under non-restrictive photographic conditions

ABSTRACT

Photo-anthropometry is a facial comparison technique that relies on measurements taken on a facial image. These measurements and the ratios between them are called “dimensions and proportionality indices” (DPIs). Traditionally, photo-anthropometry compares DPIs across facial images; however, multiple studies concluded that the procedure is reliable only when all images are acquired under the very same facial pose, expression and camera parameters [1, 2]. Nonetheless, using a much more complex approach, Martos et al. [3] demonstrated the usefulness of DPIs for filtering candidates. Using Artificial Intelligence, the authors created a series of formulas that, using the 2D DPIs from a photo, allowed them to predict the corresponding DPIs of the 3D face of the subject. These predicted 3D DPIs are then compared against those of a candidate to determine compatibility. As a result, a significant proportion of candidates can be effectively excluded.

This study provides three contributions. First, we validate the method using a significantly larger dataset, including over one hundred subjects and exhibiting greater variability in facial poses, expressions, and photographic conditions. Second, we carry out a comparative analysis of various Machine Learning techniques, and we also explore the impact of the availability of image-related information (e.g. metadata) and the challenge posed by occluded landmarks. Finally, we introduce a novel method that allows the comparison of 2D DPIs across photos, eliminating the need for 3D measurements of the actual face of the subjects. Therefore, our technique demonstrates much broader applicability.

Our findings show that both types of comparison yield reliable results and significantly reduce the number of candidates, making the technique viable. The filtering of negative cases varies between 34% and 64%, depending on the comparison scenario, while preserving all positive cases.

REFERENCES

[1] K.F. Kleinberg, P. Vanezis, and A.M. Burton. Failure of anthropometry as a facial identification technique using high-quality photographs. Journal of Forensic Science, 52:779–783, 2007. 11.

[2] R. Moreton and J. Morley. Investigation into the use of photoanthropometry in facial image comparison. Forensic Science International, 212:231–237, 2011.

[3] R. Martos, A. Valsecchi, O. Ibáñez, I. Alemán. Estimation of 2D to 3D dimensions and proportionality indices for facial examination. Forensic Science International, 287:142-152, 2018.

KEYWORDS

Facial Comparison / Photo-anthropometry / Artificial Intelligence

ORAL PRESENTATIONS III

AUTHORS Davis, D.[1]

AFILIATIONS [1] Australian Federal Police

TITLE AI vs the Australian Federal Police

ABSTRACT

Public perception of AI often overstates it’s capability to perform human tasks increasing concerns over job stability and the trade-off between accuracy and efficiency. Research has shown AI to be prone to bias and errors, following recommendations that best practice is to restrict AI to a “co-pilot” role alongside human operators. In the Australian Federal Police, the Facial Identification Team’s Forensic Artists currently completed all casework manually. Acknowledging that there is a potential efficiency to be gained, the Forensic Artists are exploring where AI can enhance existing functionality. To this effect, a pilot study has been conducted to gauge the effectiveness and accuracy of AI-produced automated Age Progressions compared to manual Age Progression using ground truth image sets. This presentation will showcase the results of this case study and initiate discussions of AI integration moving forward in the field.

KEYWORDS

AI / Age Progressions / Manual / Automated / Forensic Art

ORAL PRESENTATIONS III

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TITLE Custom Structure Preservation in Face Aging

ACKNOWLEDGEMENTS

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ABSTRACT

We introduce a novel architecture tailored for face age editing, focusing on generating structural changes in facial images while preserving key identifiable features. This work is particularly relevant for forensic anthropology, especially in applications like age progression in missing person cases. The architecture innovatively separates style and content, allowing for the adjustment of the degree of structural preservation dynamically at inference time. This flexibility is achieved through the Custom Structure Preservation (CUSP) module, which integrates seamlessly into the style-based decoder framework to selectively maintain or alter facial features based on the desired age transformation.

The method significantly advances current face aging technologies by enabling more profound and realistic transformations across large age spans. Besides, the system's ability to generate age-adjusted facial images while preserving the identity and essential characteristics of the individual can be invaluable in both solving crimes and in visualizing the aging effects on missing persons over extended periods.

Experimental validations demonstrate that this approach not only surpasses existing methods in terms of realism and fidelity in generated images but also provides a tool for forensic experts to generate multiple plausible age-progressed images under varying structural preservation settings. This capability allows for a broader interpretation of how an individual's appearance might change over time, offering forensic teams more accurate tools for identification and comparison.

KEYWORDS

Age Progression / Deep Learning / Image Generation

POSTER SESSIONS
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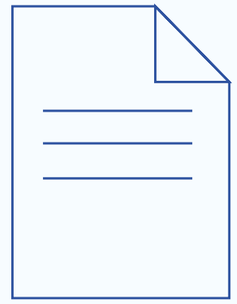

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TITLE Validation of craniofacial analysis as a means to facilitate deceased migrant identification along the Greek-Turkish migratory route in Evros, Northern Greece

ABSTRACT

The deaths of migrants attempting to reach Europe is a global concern. In the past decade alone, over 27,000 people have lost their lives while crossing the Mediterranean. Sadly, the vast majority remain unidentified. In Greece alone, an estimated 1,000 deceased migrants remain unidentified, leaving many families without answers. To help address this issue, Face Lab (LJMU), Forensic Missing Migrant Initiative, and Democritus University of Thrace (Greece) have established a website to publish Face Lab's craniofacial productions. The public website, the first of its kind for forensic cases in Greece, aims to aid in identifying missing migrants and provide closure to their families. The website also promotes research, visualizes the tragedy of migrant deaths, and remembers lost lives on migratory paths. We will be presenting an overview of the developmental considerations for the website and the outreach process. The results of the craniofacial reconstruction and post-mortem depictions and their impact on the identification process of the individuals will be shown.

KEYWORDS

Identification / Migrant / Disaster / Victim / Craniofacial

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TITLE A validation study of newly established ear morphology prediction guidelines in facial approximation

ABSTRACT

Forensic facial approximation and superimposition methods rely on understanding soft and hard tissue anatomical correlations. Guyomarc'h and Stephan analysed eight existing ear prediction methods, revealing inadequate support from computed tomography scans of 78 living adults. They subsequently proposed four newly validated prediction protocols, driven by correlations between ear features, sex, age, and facial height. This study aimed to re-examine the available protocols utilising an independent sample and trail newly proposed regression equations.

This study used 37 computed tomography scans from the New Mexico Decedent Database (deceased) and the University of Science and Technology Hospital Yemen database (living). Observations were performed in 3D Slicer. Skull placement and measurement definitions were standardised via Python scripting. All statistical tests were performed using SPSS, including testing for sexual dimorphism, asymmetry, effects of population-affinity and age.

This project largely supported Guyomarc'h and Stephan's findings. In contrast, guidelines proposing only slight differences between the height of the nose and height of the ear (c.2 mm) was found to be unreliable (explains only 13.47% of variation); no correlation was found between the supramastoid crest and auricle (p=0.149), and that lobe morphology correlated (r=0.487) with mastoid lateral angle.

Comparably high standard errors of the estimates for in-sample regression equations established in this study (especially for ear height) were comparable to those of Guyomarc'h and Stephan. Future research should focus on expanding ear approximation guidelines, potentially incorporating additional landmarks, investigating interlandmark distances and semilandmarks, or adopting a geometric-morphometric approach to enhance reliability. Furthermore, the wider implementation of deep learning in forensic anthropology could prove beneficial in identifying associations between hard and soft tissue features in the auriculotemporal region.

KEYWORDS

3D Slicer / Ear Morphology / Facial Approximation / Regression Equations

POSTER SESSIONS

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TITLE Exploratory analysis of new craniometric measures for the investigation of biological sex using open-access statistical and machine-learning tools on a cone-beam computed tomography sample.

ABSTRACT

Determining the biological sex of human remains is an essential part of physical anthropology. Given the variability in skeletal preservation, it is important to explore multiple approaches and structures of interest. This study aims to explore the potential utilization of various measurements, such as FMB, IOD, NLB, ICD, and MFD, for predicting sex using both traditional statistical methods and open-access machine-learning tools. The ethics committee approved the study and a total of 54 individuals with visible points were selected from 100 CBCT scans. The predictors developed from the learning sample were tested with ten additional exams. Measurements, standard deviation, and standard error were obtained for descriptive analysis purposes. T-student and Mann-Whitney tests were utilized to assess the sex differences within the variables. A logistic regression equation was developed and tested for the investigation of the biological sex as well as decision trees, random forest, and artificial neural networks machine-learning models. The results demonstrate a significant connection between the measurements and the variable sex. By combining the measurements, it was possible to predict sex using either a regression formula or machine learning models. These models can be exported and integrated into software or webpages. The Artificial Neural Networks model had the best results, with the estimations accuracy rate above 80% for males and 82% for females. All skulls in the test sample were accurately predicted by both statistical and machine-learning models. This successful exploratory study has proven the correlation between facial measurements and the variable of biological sex, highlighting the potential of machine learning to make predictions from linear variables and expanding the repertoire of investigative tools for experts.

KEYWORDS

Forensic Anthropology / Cone-Beam Computed Tomography / Cephalometry / Sex Characteristics / Forensic Dentistry / Three-dimensional Imaging

POSTER SESSIONS

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TITLE Facial Imaging for forensic Identification in a digital Age: Exploring new processes and platforms in unidentified and missing persons cases.

ABSTRACT

Background/Purpose: Access to appropriate resources for forensic identification in the South African context are unevenly distributed across medico-legal services, which exacerbates the demands of a high caseload burden, especially when a large number (approximately 10%) of cases are unidentified or unknown.

Technologically enhanced methods of visual identification, including craniofacial reconstructions (CRF) and facial depictions from post-mortem photographs, which present a plausible image of a living appearance of an unknown decedent, are recognised practices internationally, and while some expertise exists in the South African context, such methods have not been adequately tested or implemented within the South African and African context for forensic identification investigations.

Objective: This paper describes the research design of the first doctoral research programme in the African context to focus on improving post-mortem identification protocols and practices through forensic facial imaging. A key objective is to increase the use of visual depiction methods to support complex identification cases in the South African context. Fostering productive academic exchange between key services in South Africa's medico-legal and forensic humanitarian systems and academic institutions who contribute expert consultation services to these organisations is essential to meet this objective.

Methods: The study blends practice-based (action-reflection) methods and theoretical analysis over three phases, to determine the efficacy of forensic facial depiction in complex identification cases internationally; understanding responses to different modes of presenting such depictions to the public; and understanding communication barriers regarding identification protocols, and the sharing of information between investigation organisations and with the public in the South African context.

Results and Conclusion: Critical reflections on the affordances and challenges of the methodological approach, alongside anticipated findings from the first and second phase of the study will be reported.

KEYWORDS

Craniofacial Reconstruction / Forensic Facial Depiction / Post-mortem / Forensic Identification

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TITLE Body Size and Facial Soft Tissue Thicknesses

ABSTRACT

Facial soft tissue thicknesses (FSTTs) form the quantitative basis of craniofacial identification methods. These measurements provide a metric guide as to the depth of the soft tissues that encase the skull. Since the first FSTT publication, it has been posited that biological variables, especially body size, have a considerable impact on FSTTs, but so far body mass index (BMI) has been the predominant variable of concern. This study reviews FSTT publications to determine the frequency at which body size is considered, how it was measured, if BMI is the best factor to use, and future recommendations.

Google Scholar and Scopus were used to conduct a literature search for all adults FSTT studies. From 150 papers, 61 reported a measure of body size. Early (1895–1984) FSTT publications (n=8) used visual assessments of 'nutrition' or 'body build'. In the last 30 years (1990s–present), body size has most commonly been described via BMI (n=52), with larger individuals reported to yield larger FSTTs. Body mass and height were only independently considered in seven studies, however, body mass demonstrated comparable correlations to BMI. Some studies exclusively recruited participants of 'normal' BMI status under varying definitions (n=13). Most studies subdivided their participants into BMI categories (n=31), however, cut-off values for each group varied. Studies almost exclusively investigate raw relationships with no relative adjustment of FSTTs to body scale (n=2 exceptions)—a standard undertaking in other biological domains.

Numerous weaknesses are possessed by the BMI variable. To improve descriptions of FSTTs and their co-variation with other factors (like sex and age), we suggest that body scale must be included as standard variable and data should be normalized by body size prior to analysis by other variables of interest. In contrast to using BMI categories, the continuous variable of body mass (weight) holds advantages.

KEYWORDS

Body Mass / Body Mass Index (BMI) / Body Scale

POSTER SESSIONS

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TITLE Bringing together science, museum, and community through facial depictions of pre-Columbian Bolivian mummies: an introduction to the project

ABSTRACT

In 2021, an international collaboration between the Ministry of Cultures, Decolonization and Depatriarchalization of Bolivia, the National Museum of Archaeology - MUNARQ, and Eurac Research set the ground for an interdisciplinary (genetics, anthropology, geochemistry, and conservation) scientific research. This collaboration aimed to develop the Bolivian Mummy project (MumBo, PI Valverde) focused on the first bioarchaeological study of pre-Columbian human remains from Bolivia. The MUNARQ collection comprises over 50 mummified and skeletonised bodies, and over 500 human skulls dated to the Late Intermediate Period (1100-1450 CE) and potentially to the Inca Period (1450 – 1532 CE), many showing signs of artificial mummification and cranial modifications.

Conservation and exhibition of human remains in museums poses a controversial cultural challenge within public discourse and academic investigation. Further problematisation arises when dealing with remains from under-represented cultural communities in countries with a history of colonisation. The present project aims to investigate the use of facial depictions as a tool to contextualise human remains within the museum context and facilitate ethical dissemination to the public. The project will utilise participatory co-design methods to ensure that the relevant communities are considered and involved throughout the process of investigation and dissemination.

Facial depictions of individuals from the past can be a powerful form of data visualisation that help convey scientific findings to the general public. By collating data gathered via bioarchaeological investigation, faces of people who lived in the past tell both an individual-based and population-based narrative. For this project, anthropological, palaeopathological, and genetic information pertaining to selected individuals (gathered through MumBo) will be considered to maximise accuracy of the facial depictions. Thus, the facial depictions will serve as a tool to facilitate communication of existing knowledge of pre-Columbian population history, fostering public interest in the cultural heritage represented by the MUNARQ collection.

KEYWORDS

Bioarchaeology / Interdisciplinarity / Human Remains / Mummies / Facial Depictions

AUTHORS Joshi, S.[1]

AFILIATIONS [1] InMed Prognostics

TITLE Exploring the Potential of AI in Forensic Dental Identification: A Hypothetical Journey

ABSTRACT

This abstract outlines a hypothetical yet strategic approach to harnessing artificial intelligence (AI) for predicting age progression in forensic dental identification. Framing the challenge as an image analysis problem, the study proposes the use of a dataset containing dental images, including radiographs and facial photographs. The investigation aims to explore the effectiveness of convolutional neural networks (CNNs) in identifying key features essential for age prediction. Additionally, the potential of pretrained networks such as VGG, YOLOv7, or ResNet will be examined in preliminary exploration. By conducting training and refinement of these models with a meticulously curated dataset, the objective is to develop a tool capable of accurately predicting age-related changes in facial and dental structures. This endeavor is driven by the goal of providing forensic professionals with a reliable and user-friendly solution to enhance age estimation in forensic investigations. Through this modest initiative involving AI, the aspiration is to contribute to the progression of forensic science and promote increased accuracy in age determination for identification purposes.

KEYWORDS

CNN / Image classification / Forensic Identification / Dental Radiographs

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TITLE Automated Cephalometric Landmark Detection on Unconstrained Facial Photographs

ABSTRACT

Cephalometric landmarks are essential for forensic tasks such as anthropometric analysis, pathology detection, and forensic human identification. However, the automated localization of these landmarks, particularly in uncontrolled, in-the-wild images, remains underdeveloped. This paper introduces an innovative method using a cascade of conditional convolutional networks designed for the precise localization of cephalometric landmarks in such challenging conditions. Utilizing a small dataset typical of forensic scenarios, our method significantly enhances the accuracy and efficiency of landmark detection.

The methodology employs deep learning techniques, particularly leveraging a pre-trained deformable 3D mask model followed by a high-resolution conditional network that refines initial localizations. Our approach uniquely addresses the challenges posed by the variety and quality of forensic images which include varying poses, occlusions, and lighting conditions. The performance of our system is rigorously validated against both standard facial landmark methods and expert human annotators, demonstrating superior accuracy and practical forensic applicability.

Our results indicate a performance that matches or exceeds human experts in half of the evaluated cases, effectively doubling the accuracy of the nearest competing methods. This system has been integrated into Skeleton-ID, a commercial AI-assisted forensic identification solution, highlighting its value in enhancing the speed and reliability of forensic analyses. This tool not only facilitates rapid processing of large image sets but also supports forensic experts by providing an initial automated pass of landmark localization which can be refined manually if necessary.

ACKNOWLEDGMENTS

This work was supported by the Spanish Ministry of Science, Innovation, and Universities (MICIU) under grant FPU19/00591, grant CONFIA (PID2021-122916NB-I00) funded by MICIU/AEI/10.13039/501100011033 and by “ERDF A way of making Europe”.

KEYWORDS

Cephalometric Landmarks / Craniofacial Superimposition / Forensic Facial Comparison Facial Recognition

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TITLE Skeleton ID C-Rank: 3D Methodology for Frontal Sinus-based Human Identification

FINANCIAL SUPPORT

This work was supported in part by MCIN/AEI/10.13039/501100011033 and ERDF "A way of making Europe" under Grant CONFIA PID2021-122916NB-I00. Additionally, E.B's work has been funded by MCIN/AEI/10.13039/501100011033 under grant PTQ2022-012457.

ABSTRACT

The distinctive morphology of the frontal sinuses makes them a valuable tool in forensic anthropology for human identification purposes. This anatomical structure has been widely studied using both bi and three-dimensional images as they are easily visualized using radiology (X-Rays, Computed Tomographies and Magnetic Resonance Imaging). The images obtained by these methods are used in human identification by, manually, comparing the different shape and size of the frontal sinuses in ante-mortem (AM) and post-mortem (PM) images.

In this work we propose a novel technology to make the registration and posterior analysis of multiple cases simpler and fastest. Using 3D feature extraction techniques, we have developed a method to register and visualize AM and PM images in order to rank the cases by similarity, thus making the search of a match between the AM and PM cases more efficient. We also developed different segmentation protocols in order to standardize the data acquisition process to obtain the 3D models needed to make the comparison from medical images and studied the intra-subject variability.

A preliminary study served us to validate the tool and the protocols. Different forensic anthropology practitioners with different expertise levels followed the protocols to segment and process the data while attempting to identify multiple cases using the software. In this work we will present the promising results achieved in our study, as well as the viability of the proposed methodology.

KEYWORDS

Frontal Sinuses / 3D Image Registration / Post-mortem Identification

POSTER SESSIONS

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TITLE Consequences of focus breathing in craniofacial identification: Focus distance estimation and synthetic image generation

ABSTRACT

Craniofacial superimposition involves overlaying a skull and face image for anatomical comparison. For this comparison to be valid, the photographical variables of the two images must match. This includes the focus distance (FD), the distance between the subject and the camera, which affects how the structure of the face appears in a 2D image. To match this distance, the FD of the antemortem face photograph must first be estimated, allowing the estimate to be used during photography of the skull. To facilitate this, multiple methods of FD estimation have been created. Although exact methodology differs, current FD methods require the focal length an image to be known. Focal length refers to the distance between the lenses and image sensor in a camera and determines the angular field of view of a lens.

Focus distance estimation methods typically use the focal length reported by a camera, located in image metadata. However, this value may not always be accurate, due manufacturer reporting and/or the phenomenon of focus breathing, where the focal length of a lens changes to bring an image into sharp focus. This focal length change is not reported by the camera/lens, which may have consequences for focus distance estimation.

Focus breathing may hold additional ramifications for synthetic image generation, where images are created using 3D rendering software. Synthetic images have been used to supplement real-world datasets in research, however, as virtual cameras do not exhibit focus breathing, the focal length of synthetic and real photographs may not match. This may affect their use in craniofacial superimposition.

To measure the changes in focal length caused by focus breathing, a scale was photographed with multiple lens at multiple distances with different degrees of focus. Preliminary analysis shows that the average difference in the field of view due to focus breathing was 3.42°.

KEYWORDS

Craniofacial Superimposition / Focal Length / Focus Breathing

POSTER SESSIONS

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TITLE Evidence Evaluation in Craniofacial Superimposition Using Likelihood Ratios

ABSTRACT

Craniofacial Superimposition (CFS) is a key forensic identification technique that supports decision-making when skeletal remains are involved. Despite its importance and wide applicability, the process remains complex and challenging. In the last years, computerized methods have been proposed, but subjectivity and qualitative reporting persist in decision-making. To address these challenges, a decision support system based on Likelihood Ratios (LRs) has emerged as an appropriate tool, which has been recommended by the ENFSI.

This poster presents a novel application of the LR framework to CFS, which has previously been used in other forensic fields such as DNA, voice, fingerprint, and facial comparison. Our study evaluates the effectiveness of the resulting innovative LR system through three experimental setups using synthetic data to simulate real-world conditions: the first experiment utilizes frontal facial photographs, the second uses lateral photographs, and the third combines both frontal and lateral images. This approach allows us to assess the system under different conditions.

Preliminary results indicate that the LR system stands out in terms of calibration and discriminating power, which are performance metrics commonly employed in literature. This suggests that our proposal could provide reliable and objective decision support in forensic identification scenarios. However, while promising, these findings are derived from synthetic data and thus represent a proof of concept. Therefore, further validation using actual casework data is proposed as future work to confirm the effectiveness of the system under real-world conditions.

In summary, this poster encapsulates the integration of a quantitative LR framework into CFS and demonstrates its potential to enhance the objectivity and reliability of forensic evaluations. This could be essential for future applications in forensic science, so further research and validation become essential to move from theoretical innovation to practical utility in forensic casework.

KEYWORDS

Skeleton-based Forensic Human Identification / Craniofacial Superimposition / Likelihood Ratio / Decision Support System

POSTER SESSIONS

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TITLE Combining 3D morphology with artificial intelligence: what are the hopes for bioarchaeology and forensic anthropology?

ABSTRACT

This bioanthropological doctoral project proposes an innovative approach to human identification by integrating Artificial Intelligence (AI) with 3D cranial morphology. Traditional methods for estimating biological sex and population affinities often encounter biases and limitations. To overcome these challenges, this study proposes employing AI algorithms capable of simultaneously estimating sex and biological affinities from 3D cranial data. While machine learning applications in bioanthropology are emerging, few studies have focused on these specific tasks, particularly concerning incomplete remains.

The project aims to train an AI system using a dataset comprising 1 800 crania for training and 200 for testing purposes. Collaborative efforts with multiple institutions ensure access to diverse osteological collections from various geographical regions. Through AI capabilities, this research aims to reduce analysis errors, speed up results, facilitate on-site usage, and adapt methodologies for various anthropological challenges, such as variable skeletal preservation.

This research has three objectives: 1. Supervised deep learning algorithms will analyze complete crania geometry for biological sex and population affinities estimation; 2. Unsupervised deep learning algorithms will be also used to potentially uncover previously unnoticed morphological traits; and 3. Supervised deep learning algorithms tailored to analyze fragmentary crania will be developed to classify the latter based on biological sex and population affinities.

The hypothesis suggests that AI models will outperform traditional morphometric methods in accuracy and effectiveness, while also uncovering morphological traits that were previously overlooked. Additionally, AI's ability to better identify incomplete human remains is anticipated to enhance forensic and bioarchaeological analyses. Thus, this presentation will elaborate on the theoretical framework guiding our main objectives as well as our preliminary results.

KEYWORDS

Artificial Intelligence / Bioanthropology / Population Affinities / Biological Sex Estimation / 3D Techniques / Forensic Anthropology

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TITLE Craniofacial Superimposition of the unknown skeletal remains of partissans killed in the Fontodocte massacre (Italy, 1944): an assisting tool to anthropological analysis

ABSTRACT

Members of Italian resistance movement played a crucial role during the Second World War for the liberation from nazist and fascist regime and lost their lives in that attempt. Some bodies have never been recovered nor identified and in the Fondotoce massacre, carried out by nazis in the Valgrande area (Piedmont) in 1944, 43 partisans were executed. In an attempt to reconstruct their identity, the 'Casa della Resistenza' Association of Verbania, the Valgrande National Park Authority and the municipal authorities of Verbania and Baveno and LABANOF (Laboratory of Forensic Anthropology and Odontology) of the University of Milan signed an agreement to carry out this task. In 2023, 35 unidentified human skeletal remains have been exhumed and the post-mortem analysis started. Antemortem data were collected in a series of interviews with family members, that led to collect profiles of 17 people of which only eleven included photographs of the missing. The skeletal remains underwent anthropological and radiological examinations for subsequent comparisons with antemortem data.

In this research we present the preliminary results of one of the craniofacial superimpositions, a step of this extensive anthropological investigation. Two individuals were selected, based on their biological profiles, as a possible match with one of the missing persons. The skeletons (assessed as 16-22 yo) and the missing (19 yo) presented a compatible age range and similar dental anomalies, according to the reconstructed biological profile and a close observation of the photograph. The superimposition (Gordon and Steyn, 2012) was attempted in order to carry out an exclusion of the suspected identity. The 3D models of skulls and mandibles were extracted from the CT scans through open-source software (3DSlicer) and imported in Blender (Blender Foundation), where they were aligned and superimposed to the photograph of the missing person which led to an exclusion of identity.

KEYWORDS

Craniofacial Superimposition / Anthropological Superimposition / Skeletal Human Remains

POSTER SESSIONS

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TITLE Automatic skull segmentation in CBCT images using AI-based methods

ABSTRACT

Cone beam computed tomography (CBCT) is a medical imaging technique widely used in dentistry to obtain three-dimensional images of the head and skull [1]. It differs from a standard tomography (CT) scan mainly in the radiation dose received by the patient. Therefore, the use of this type of imaging has become increasingly popular in recent years within the fields of medicine, dentistry and anthropology. However, due to this reduced radiation dose, images obtained by CBCT have higher levels of noise and artifacts. This noise translates into segmentations showing deviations in the real amount of bone tissue present across the skull morphology, as well as aberrations in the dentition area, making subsequent analysis challenging. Accurate segmentation of anatomical structures, such as the skull, is essential for morphological analysis, landmark annotation and soft tissue studies among other relevant techniques in craniofacial identification. In this context, the automation of the skull segmentation process in CBCT presents itself as a crucial area of research to improve efficiency and accuracy in various application domains.

The aim of this work is to develop an automatic skull segmentation method designed to specifically address the noise generated in craniofacial CBCT images. For that purpose, we have proposed a combination of image preprocessing techniques alongside advanced machine learning and artificial intelligence methods aimed at mitigating the typical data loss inherent in the segmentation process. We have performed a comprehensive comparative study with current methods, focusing on evaluating the accuracy and performance of the proposed method. In this work, we will present the results achieved and explore the limitations of current techniques.

[1] D. Miles y R. Danforth, «A clinician's guide to understanding cone beam volumetric imaging (CBVI)», Acad Dent Ther Stomatol, pp. 1-13, ene. 2007.

KEYWORDS

Cone Beam Computed Tomography / Medical Image Segmentation / Machine Learning

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TITLE Attempting to empirically categorise shapes of craniofacial features, to evaluate the current standards of craniofacial identification across diverse populations

ABSTRACT

This project aims to enhance the diversity of response within the criminal justice system by overcoming the difficulties of identification from partially decomposed and skeletal human remains across diverse populations.

The current standards of craniofacial identification have been produced from assessing the relationship between bone and soft tissue of the head. The original standard samples are often limited and lack diversity during development. These limitations reduce the reliability of the standards on other populations. Furthermore, population cannot always be identified in forensic scenarios, especially in cases of migrant disaster victim identification. Therefore, by evaluating the methods across diverse populations, more reliable methods can be developed for more successful global identification.

As part of this project, scientific methods for shape categorisation of craniofacial features will be investigated to compare the bone to soft tissue relationships across those categories. Current methods for describing and categorising the morphology of craniofacial features are typically macroscopic and provide unspecific and unclear criteria which can lead to high interobserver errors. Using scientific methods, this project will create empirical craniofacial feature morphology categories that can be used across diverse populations.

The aim for this project is to determine the success and limitations of using current craniofacial standards across diverse populations, with the prospect of improving current standards and/or producing more appropriate standards where possible. To do this, relationships between bone and soft tissue will be categorised by shape in place of population, allowing for higher accuracy in human identification from facial predictions for individuals from diverse populations and of unknown origin (e.g., migrants).

KEYWORDS

Craniofacial / Identification / Morphology / Shape

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TITLE Reliability and Accuracy of Approximated Faces using AFA3D: Pilot evaluation of Facial prediction differences across a Czech CT sample

ABSTRACT

Skull-based facial approximation software involves computerized facial soft-tissue (FST) calculation on unidentified virtual skulls, which can be used for possible identification of unknown individuals. Software such as Freeform® Modelling-Plus™, FaceIT, ReFace have collectively presented with overestimations of nasal region and underestimations of the lower third of the face. AFA3D is a statistical facial shape estimator that uses FST depths, estimated by craniometrics, warping and iterative algorithms, thus giving a global facial appearance. Guyomarc'h et al.,(2014) developed it on a French sample, finding moderate and smaller errors in mouth and nasal, eye regions, respectively. Assessments of accuracy and recognition level of predicted faces have never been conducted and we hypothesize that AFA3D can also present with similar under/overestimations when used on a different population.

The aim was to validate AFA3D, by evaluating facial variations associated with the reconstructed/approximated faces, predicted using virtual skulls and their original facial meshes from Czech CT scans. 10 individuals across an age range of 22-75 were considered. Original and approximated soft-tissue meshes were analyzed using Morphom3cs II, involving geometric morphometrics such as CPD–DCA, per-vertex T-test, super-projection and results visualized using color-coded and significance maps.

Assessing generated average facial approximation, the glabella and lower third of the face were underestimated whereas zygomatic, buccal, parotid-masseteric regions (cheek) were overestimated compared to original surface meshes. This may be attributed to Czech skulls being more globular and their faces wider than the French. Overall, 9 /10 approximations presented with a similar pattern but with various intensities and differences across facial regions, owing to individualistic facial-shape variations. Shell-distance maps showed statistical significance in the glabella, zygomatic, lower third of the face and both alar crease regions. Nevertheless, AFA3D can still be considered as a useful facial shape estimator by incorporating appropriate population based validations and functions to increase accuracy.

KEYWORDS

Anthropological Facial Approximation in 3D (AFA3D) / CT data / Geometric Morphometrics;/ Surface Mesh Analyses / Accuracy

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TITLE Can sequential unmasking reduce bias in facial image comparison decision making?

ABSTRACT

Facial image comparison (FIC) is often used in police investigations and the judicial system to determine if an offender and a suspect are the same person by assessing for similarities/dissimilarities of the faces. The Facial Identification Scientific Working group (FISWG) advises using a morphological comparison technique where individual features and characteristics are compared in a piecemeal fashion. Current practice involves viewing whole face images throughout the assessment, however, it is known in face recognition literature that viewing whole faces allows for holistic judgments to be made about a face. These initial judgements can introduce cognitive bias into the process, in particular confirmation bias (only looking for evidence that supports your initial opinion). Cognitive bias has been extensively reported on within forensic practice, with various strategies proposed to mitigate and reduce its effects. For example, case specific information may be withheld from the forensic practitioner, or information may be provided but in a piecemeal manner, known as sequential unmasking.

To reduce cognitive bias, a pilot study tested the application of sequential unmasking to face images. Paired face images were obscured on first presentation to the practitioner, with facial features gradually revealed as they made their way through the comparison. A small group of practitioners who carry out FIC were recruited and tested to compare current procedure with the sequential unmasking procedure. They were requested to report on their comparison decisions at various stages to assess whether the effects of cognitive bias had been reduced. The pilot results will be presented and will inform current FISWG FIC best practice guidelines. Reducing cognitive bias within forensic practice undoubtedly has a positive effect as it increases its impartiality and validity within investigative and judicial systems.

KEYWORDS

Facial Comparison / Facial Identification / Cognitive Bias

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TITLE Age and Sex-related changes of the frontal air sinus from childhood to early adulthood (1 to 25 years)

ABSTRACT

Frontal sinus morphology in human identification is a known alternative method, however, its value in age and sex estimation is debatable. Therefore, this study aimed to illustrate the three-dimensional (3D) morphology of the frontal air sinus according to age 1 to 25 years in a South African population cohort. The frequency of the morphological frontal sinus traits viz. Presence, shape, scalloping, and septa were observed in 3D reconstructed frontal air sinus models. The sample (n=480 CT images) consisted of 276 males and 204 females, 1-25 years, and of two population groups, South African black African and white. Overall, the air sinus was present in 75.8% on the right and 77.5% on the left. It was absent bilaterally (20.4%) and in 19.6% males, 21.6% females, 20.6% black African and 19.1% white subjects. The frequency of aplasia was notably higher from one to nine years of age. Eleven different shapes were observed in the anterior/coronal view with the main shapes being triangular, right triangular, parallelogram, M-shaped, and crown-shaped. Three shapes in the sagittal view were observed viz. flat, convex, and concave, with the concave shape observed mainly on both sides (43.5% R; 40.0 L). The morphological shapes changed with age and were associated with sex albeit on the left side only. Along the superior border, it had a scalloped appearance, with up to eight scallops noted in the black African female. Intersinus septa was observed in 73.1% and located centrally in 37.5%. A middle air sinus (4.0%) and fronto-ethmoidal air cells (1.9%) were noticeable variations. This study highlighted the variable 3D forms of the frontal air sinus according to age, sex and population groups, and its use forensically. It also described the morphological changes with age in a subadult group within this population.

KEYWORDS

Frontal Air Sinus / Development / 3D Reconstruction / Forensics / Morphology

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TITLE Craniofacial analysis of the orbit: The Human Bone Collection, and dental CBCT from Hong Kong and Korea

ABSTRACT

The relationship between the skeletal traits of the orbit, and the shape of the epicanthus is not well studied. Through an observation study of n=112 Dry skull specimens (16F, 78M, 17X) and n=65 dental CBCT (34F, 31M) from the University of Hong Kong, thirteen areas of the orbit were observed for both morphological and metric analysis. Five soft tissue descriptors were also defined from the CBCT soft tissue. The skeletal parameters were compared to the soft tissue descriptors and tested on a Korean population based on CBCT, and facial images (n=277). The methodology, challenges, and initial findings of this project will be disseminated. Area of interest includes 3D scanning of the skull collection using iPad, soft and hard tissue visualisation of the CBCT, repeatability of the morphological assessment (interobserver), and the correlation between the skeletal features and the soft tissue expressions.

The Human Bone Collection (n=368) housed at the Faculty of Dentistry at the University of Hong Kong, are archaeological unclaimed human remains exhumed from local cemeteries in the 1980s. The individuals are of southern Chinese descent. Together with the contemporary dental CBCT archive from the dental department, both collections are accessible to local and international institutions for teaching and research purposes from the University of Hong Kong.

KEYWORDS

Facial reconstruction/approximation / Craniofacial anatomy / CBCT / Skeletal Collection

POSTER SESSIONS

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TITLE Positive identification of the deceased man through craniofacial superimposition

ABSTRACT

In 2023, Rzeszow City Police Department made a request to the Institute of Forensic Research in Krakow to help identify a human remains of the deceased man found inside a storage room in a building near the city center. The institute's task was to perform an anthropological assessment, a facial approximation and craniofacial superimposition. The following evidence were delivered: skull with mandible (both teethless), two separate teeth, four fragments of femora, medicolegal report and comparative data of the previously marked out man – two printed photographs and a police crime database description. Examination have shown the remains belong to a probable elderly male of European origin, with approximately 175 cm of height. No perimortem trauma was identified, but within facial area there were present healed fractures of the right zygomatic bone, vomer and both nasal bones with bone overgrowth on the left side. The nose curvature towards left was visible before death. To perform a facial approximation and craniofacial superimposition skull was scanned with Artec Space Spider 3D hand scanner. Superimposition showed a match between the skull and two photographs of the selected man. There are no discrepancies between the corresponding anthropometric points and the morphology of the face and skull. Additionally, each asymmetry, such as: oblique lower edge of the chin, higher right angle of the mandible, fractures in the right zygomatic bone and thickening of the bridge of the nose due to multiple fractures, overlaps in both images. Due to the lack of teeth in both maxilla and mandible, and therefore the impossibility of determining the correct dental occlusion, final result of the comparison was assumed as consistency with limited support (according to the MEPROCS criteria).

KEYWORDS

Craniofacial Superimposition / Human Identification / Facial Reconstruction / Trauma Analysis

POSTER SESSIONS

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TITLE Assessing skull-face overlay using Deep Learning

FINANCIAL SUPPORT

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ABSTRACT

Craniofacial Superimposition is probably the most challenging [1,2] skeleton-based identification method. Despite its potential, it has not been adopted because of its known drawbacks: manual, repetitive and tedious tasks that rely on expert knowledge and subjective evaluation. Over the last decade, several computer algorithms have been developed to overcome these limitations. However, they are not able to assess all anatomical correspondences between the face and the skull; instead, they rely on matching landmarks and a few specific anatomical criteria.

In this work, we introduce a novel approach based on Artificial Intelligence (AI) to automatically evaluate a skull-face overlay. We created a large database of overlays through the extensive use of synthetic photographs simulated from CT and CBCT scans. The overlays were labeled positive or negative, whether the skull and face belong to the same subject, as well as correct or incorrect if the skull and the face display the same pose and photographic conditions or not. The AI algorithm was then trained through examples and it eventually learned how to classify the overlays among the different classes.

Our experiments show that this approach has potential and may be considered as a support tool during the CFS process, both for human experts and other AI approaches. Nonetheless, an in-depth analysis of the introduced approach is necessary to further unveil its capabilities.

REFERENCES

[1] Ubelaker DH (2015) Craniofacial superimposition: historical review and current issues. J Forensic Sci 60:1412–1419

[2] Damas, S., Cordón, O., Ibáñez, O. (2020). Handbook on Craniofacial Superimposition. Springer, Cham.

KEYWORDS

Craniofacial Superimposition / Deep Learning / Machine Learning / Human Identification

POSTER SESSIONS

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TITLE CA22106 Migrant Disaster Victim Identification

ABSTRACT

Illegal immigration and economic migration are global issues that lead to numerous deaths. A significant number of undocumented migrants are still missing, and the process of identifying deceased migrants is inadequate, with only 22% of them being identified. The lack of communication between countries and relevant stakeholders is one of the contributing factors. It is necessary to adopt an interdisciplinary approach to develop and validate international processes and resources, including the use of innovative identification methods. To address this problem, Face Lab is coordinating the Cost Action CA22106 Migrant Disaster Victim Identification, with four working groups focusing on Physical Evidence, Digital Evidence, International Policy, and CPD. We are presenting a poster to showcase the action and discuss the key points addressed by working groups.

KEYWORDS

Identification / Migrant / Disaster / Victim

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TITLE Morphology and Morphometry of the Hypophyseal Fossa in Relation to the Sphenoid Air Sinus: A CT Scan Study

ABSTRACT

The hypophyseal fossa, a hollow cavity in the sella turcica, houses the pituitary gland. The sphenoid air sinuses are two large cavities enclosed within the body of the sphenoid bone. Expanding the exploration of the relationship between these two anatomical structures within the South African population is necessary for developing alternative methods in age and sex estimation. The study aimed to assess the morphology and morphometry of the hypophyseal fossa in relation to the sphenoid air sinus in a Black South African population utilising computed tomography (CT) scans. A dataset of 80 CT images of Black South African patients (50 % sex ratio; 1-18 years) were assessed. The shapes of the hypophyseal fossa and the sphenoid sinus were assessed as well as the relationship between the two structures. The lengths and depths of the hypophyseal fossa were also measured. The most common morphology of the hypophyseal fossa was normal (73.8 %) and was prevalent across all age groups. The most common morphology of the sphenoid sinus was the conchal type pneumatization (42.5 %). The relation between sphenoid air sinus and hypophyseal fossa morphology was statistically significant (p=0.039). The average length and depth of the hypophyseal fossa were 11.2 mm and 7.94 mm, respectively. The Black South African population reflected normal morphology of the hypophyseal fossa and a conchal type of pneumatization of the sphenoid sinus. The hypophyseal fossa depth increased with age, which is slightly faster in females, and has a positive correlation with the sphenoid air sinus morphology. The research highlighted the interplay between age and sex in the changes observed in these two structures, offering potential applications in forensic analysis.

KEYWORDS

Computed Tomography / Hypophyseal Fossa / Morphology / Morphometry / Sphenoid Air Sinus

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TITLE Collaborative Image Sharing for the Identification of Deceased and Unidentified Migrants

ABSTRACT

The working group of experts in forensic odontology and informatics, affiliated with the Medicolegal section of the University of Turin, intends to establish a humanitarian forensic sciences service for deceased and unidentified migrants and their families. A website called “migrant identiface” has been created to promote this initiative, which is linked to the Human Identification and Forensic Odontology Laboratory (LIPOF) at the University of Turin. The aim is to encourage families of migrants who have gone missing during their journey to Europe to send a photo of the missing person and any other details they deem useful for the search and identification process, through a dedicated email address.

The LIPOF will then create a database of portrait photos and personal effects images, which will be made available to the authorities and forensic operators responsible for conducting identification autopsies of deceased migrants. In this way, LIPOF becomes an additional point of contact not only for international organizations assisting migrants, but also for families who may be reluctant to share information with local police agencies, as they can contact the website and LIPOF without any negative consequences. Additionally, a computer-assisted comparison service will be provided, allowing for the comparison of received images of missing migrants with images made available by authorized forensic experts and associations of missing persons, both Italian and foreign.

This initiative, already present in other universities and television programs in Italy, is specifically focused on migrants from outside the European Union and employs multilingual support, with particular attention to the nationalities of origin of the migrants. It serves as an additional humanitarian forensic tool in the identification processes to alleviate the suffering of families. Authors propose this initiative to the forensic community as a valuable contribution to the field of migrant disaster victim identification.

KEYWORDS

Humanitarian Forensics / Deceased Migrants / Missing Persons / Migrant Disaster Victim Identification

POSTER SESSIONS

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TITLE Analysis of CBCT images of craniofacial structures from living brazilian individuals: evaluation of a method for ancestry estimation

FUNDING

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ABSTRACT

Craniofacial identification of the deceased, when there are no suspects and only bones are found, includes the estimation of the biological profile, with ancestry estimation being an important variable in this context. Various methods for ancestry estimation are found in the scientific literature. The method proposed by Hefner (2009) analyzes 11 cranial morphological structures (qualitative or non-metric method), and has been tested in different populations. The Brazilian population is characterized by extensive racial mixing, and individuals may exhibit several characteristics from different ancestral groups. The advent of new technologies and the use of imaging techniques in forensic sciences have enabled the analysis of features in modern, living individuals, not only in skeletal remains or collections, that may not accurately represent current population characteristics. This research aims to evaluate the effectiveness of the mentioned method in living Brazilian individuals through the analysis of cone beam computed tomography (CBCT) images. Following the analysis of the 11 craniofacial structures, the probabilities for the individual belonging to the different ancestry categories proposed by the author are calculated. The obtained classification is then compared with the individual's ancestry/skin color (officially categorized in Brazil). Initial results indicate that in some cases, the estimated ancestry is accurate, but in others, it is entirely incorrect. Although preliminary, these errors can be attributed, at least partially, to Brazil's population admixture.

KEYWORDS

Craniofacial Identification / Ancestry Estimation / Forensic Imaging / Cone Beam Computed Tomography / Virtual Forensic Anthropology

POSTER SESSIONS

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TITLE CBCT 2D and 3D analysis of paranasal sinuses and craniofacial structures in Ibero-Brazilian individuals. Ancestry and sex estimation using machine learning

ABSTRACT

The advent of new technologies has provided significant advancements in the field of Forensic Sciences, especially in Forensic Anthropology and Dentistry, and Legal Medicine. Artificial Intelligence (AI) can be considered a field of research that seeks to mimic human abilities, and Machine Learning (ML) corresponds to an area of AI that trains a machine to learn. ML can be used in Forensic Sciences for various purposes. This project aims to perform 2D and 3D digital measurements of paranasal sinuses and craniofacial structures in CT scan images, and estimate ancestry and sex using machine learning of an Ibero-Brazilian population.

This research is conducted in two stages. The first phase of this project consists on 2D and 3D measurements of craniofacial structures and paranasal sinuses in CT scans of living adult Spanish and Brazilian individuals, considering variables such as age, sex, skin pigmentation, and nutritional status. The measurements obtained in this phase will form a database that will be used in the next phase.

Once the first phase is completed, the parameters to be used in the estimation of ancestry and sex will be defined, and the algorithms for making these estimations using machine learning will be selected.

The second phase of this project, which will be carried out after analyzing the results obtained in the first phase, consists on estimating ancestry and sex using machine learning. The database used for the estimation will correspond to the CT scan images employed in the previous stage.

This poster disseminates the initial results from phase one of this project.

KEYWORDS

Craniofacial Identification / Machine Learning / Paranasal Sinuses / Craniofacial Structures / Forensic Imaging.

POSTER SESSIONS

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TITLE Forensic facial reconstruction: Facial soft tissue thickness data in a male multi-ethnic group. Computer tomography Study

ABSTRACT

Forensic facial reconstruction (FFR) has been used as an adjunct for identification in forensic and archaeological sciences. Especially more relevant in cases were obtaining a DNA sample for comparison might be difficult. Also, in places where DNA database may not be robust.

Facial soft tissue thickness (fstt) is essential for FFR. Cadaveric measurements from the recent deceased have been shown to be inaccurate. Different imaging types have been used in fstt measurements, these includes cephalometric radiographs, ultrasound scan, magnetic resonant imaging, computer tomography (CT) and more recently cone beam computer tomography

In this study fstt measurements were taken from CT scans in 55 Nigerian male patients. These were CT scans of the Head and Neck regions that had been done for reasons unrelated to this study. Measurements were taken from 12 mid-sagittal and 19 bilateral points (left and right, 38), totalling 50 points in 6 different Nigeria ethnic groups. These measurements were taken with a software called RadiAnt. Statistical analysis of these fstt values were done for these ethnic groups combined. Further in-depth analysis was done on its most represented ethnic type, the Hausas. Databases of fstt has been created for these ethnic groups combined and with more in-depth database for the Hausa males.

FFR may become more relevant because of its ever-increasing population, hence optimising FFR with its own unique fstt may become significant

KEYWORDS

Human Identification / Facial Reproduction / Facial Approximation

RECORDED PRESENTATIONS

RECORDED PRESENTATIONS

RECORDED PRESENTATIONS

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TITLE Automated Facial Approximation of Unidentified Human Skulls

FINANCIAL SUPPORT

ICRC and EPFL

ABSTRACT

The issue of unidentified remains that cannot be traced back to their families or communities is an increasing humanitarian concern. Bodies of unidentified migrants are being recovered on a daily basis from the sea or along rough migratory routes. Similarly, commingled unidentified remains recovered from mass graves in conflict or post-conflict contexts constitute a continuous challenge. It is common practice for the International Committee of the Red Cross (ICRC), as part of its mandate, to advise authorities to document and temporarily bury the unidentified deceased in a dignified manner, hoping that one day these unidentified bodies will be re-examined, identified, and handed over to a loved one who has spent years searching. This research is aiming to assist this process.

The aim of this research is to explore the possibility of using recent computer vision techniques, more specifically generative models, to predict the 2D/3D facial image of a human from their skull image. To build and train these models we are collecting large amounts of CT scan data of human heads, both soft and hard tissue, from a variety of sources. These scans are analysed and cleaned using an automated cleaning technique that will provide a 3D rendered skull and a 3D rendered soft tissue head. To further augment the generative model, colour photographs of the corresponding faces will be included in the training to facilitate auxiliary facial data. This by no means will be considered as a tool for identity confirmation but rather a strong lead to the possible identity.

The use of state-of-the-art computer vision techniques aims to connect two separate fields into a common goal. This remains an underexplored and needed area of development that may provide a key development in aiding the overall identification process.

KEYWORDS

Computer Vision / Facial Approximation / Unidentified Human Remains / Humanitarian Forensics / Artificial Intelligence

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TITLE Correlation between the Tweed and Northwestern Profile Assessments with Facial Soft Tissue Thickness (FSTT) in the Japanese Population: a Preliminary Study

ABSTRACT

Previous studies have linked facial soft tissue thickness (FSTT) to factors such as sex, age, BMI, skeletal class, and cephalic index. Meanwhile, other assessments like the Tweed and Northwestern Profiles, have been developed to analyze facial features, which may have correlations with FSTT. These assessments are widely used to assess dental, maxillary, and mandibular structures concerning their relationship with facial morphology and the necessity for orthodontic treatment.

This study aimed to explore correlations between Tweed and Northwestern profiles and FSTT, as well as to assess whether their inclusion improves FSTT prediction accuracy. We also aimed to integrate skeletal class and cephalic index variables into our predictive model to evaluate their impact.

We analyzed 65 sets of postmortem computed tomography (PMCT) data from Japanese cadavers aged 10–86 years. Independent variables included sex, age, BMI, skeletal class, cephalic index, Tweed profile (with three sub-variables), and Northwestern profile (with 13 sub-variables). FSTT, measured at 36 landmarks across the facial region (10 midlines and 26 laterals), was the dependent variable.

Correlation analyses were followed by multivariate regression to create a predictive model comprising 21 variables. This comprehensive model, including sex, age, BMI, skeletal class, cephalic index, Tweed profile, and Northwestern profile, was compared to a simpler three-variable model (sex, age, and BMI). Evaluation metrics included root mean squared error (RMSE), mean average error (MAE), and R2 tests.

Our 21-variable model consistently outperformed the three-variable model, with lower RMSE and MAE values and higher R2 values across all landmarks. Thus, our regression-based model incorporating Tweed and Northwestern profiles and skeletal class and cephalic index demonstrated superior FSTT prediction performance. Further research on a larger population is warranted to continue exploring the association between Tweeds and Northwestern profiles with FSTT, and to refine the accuracy of our predictive model.

KEYWORDS

Facial Approximation / Facial Soft Tissue Thickness / Japanese / Northwestern Analysis / Tweed Analysis.

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TITLE Role of DNA in Forensic Facial Approximation: Current and Future Perspectives in Indian Context

ABSTRACT

Background: Facial approximation using DNA is an emerging technique for reconstructing the facial appearance of individuals from skeletal remains. It bridges forensic science with genetics, offering unprecedented insights into the appearance of individuals from skeletal remains. Facial approximation using DNA analysis represents a transformative approach in Forensic anthropology, bridging the gap between genetics and facial morphology.

Objectives: To explore relevant original research publications utilizing the DNA for facial approximation and analysis for facial approximation in Indian medico legal contexts.

Materials and Method: The Advanced search strategy of Google Scholar was used to search the original research publication to collect the article using the keywords facial approximation, facial recognition, forensics, DNA, Skeletal remains, and Cranial identification, with the boolean terms. We also explored real cases where facial approximation was established by DNA analysis for identification purposes.

Result: Facial approximation using DNA is an emerging forensic technique aimed at reconstructing the facial appearance of individuals from skeletal remains. There are certain researchers who are extensively working on DNA facial approximation but it is also inferred by them that it is premature to say that the technology is the best one because of several reasons. In a country like India, research in the forensic facial approximation is not yet approached and due to the poor validity of the technique acceptance as evidence in a court of law is doubtful.

Conclusion: When technology meets biology and is applied in forensics, it definitely helps medicolegal cases when identification is nearly impossible. The admissibility of DNA-based facial approximation as evidence in Indian courts poses challenges due to the need for validation, standardization, and legal precedents. Forensic DNA analysis is emerging as scientifically accepted for facial approximation but needs rigorous validation and expert testimony to establish its reliability and accuracy.

KEYWORDS

Facial Approximation / DNA Analysis / Skeletal Remains / Forensic Anthropology / India

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TITLE Morphing Multiple Age Progressions to Create the Most Discriminable Images

ABSTRACT

Missing persons investigators commission age-progressed images to update appearances of individuals and generate leads from the public. These images have intuitive appeal given they depict a person's current facial appearance, whereas outdated photographs may generate erroneous leads. One strategy to improve their effectiveness involves "morphing" multiple age-progressions of a single individual made by separate artists into a single image. The present study compared morphs to single age-progressed images in a serial identity verification task. Participants were presented image pairs featuring age-progressions made by artists or morphs of multiple age-progressions of a single target alongside real photographs and judged identity on a scale of 1 (not same person) to 6 (same person). Age-progressions were made over three age ranges and comparison photographs depicted targets or foils. Discriminability was greater and response bias more conservative for morphs than for single progressions measured in aggregate. ROC analyses revealed morphs at shorter ranges offered greatest performance at every level of subjective confidence.

KEYWORDS

Age-Progression / Composites / Eyewitnesses, Missing Persons

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TITLE Can eye-tracking metrics predict accuracy on a facial identification task?

ABSTRACT

Professional screeners verify identification cards (IDs) across several security settings. However, research has shown that identity-verification tasks can be error-prone. When screeners fail to detect fake IDs, security is ultimately compromised. Our experiment investigated the sources of these errors using behavioral and physiological indices (i.e., eye-tracking). Across 48 trials, participants wearing mobile eye-tracking glasses verified whether a physical ID card matched a facial video presented on a computer monitor. Six response options ranged from definitely no to definitely yes. A standard facial matching instrument (i.e., Kent Face Matching Task; KFMT) allowed for additional comparisons that may be valuable for prescreening employment purposes. In terms of behavioral outcomes, performance on the KFMT predicted accuracy (d') but not response bias (c) on our ID matching task. In terms of eye tracking outcomes, we coded for four areas of interest: ID card facial information, ID card non-facial information, Monitor facial video, and Monitor non-facial video. We found that longer fixation durations and more fixation counts on the facial video reduced performance on match, but not mismatch, trials. In other words, more time visually scanning the facial video was associated with a greater likelihood of rejecting a genuine ID. In contrast, longer fixation durations on the non-facial information of the ID card (e.g., biographical details irrelevant to the face matching task) reduced performance on mismatch, but not match, trials. In other words, distraction driven by task-irrelevant visual details was associated with greater likelihood of accepting a fake ID. This research adopts evolving technologies that will increase our knowledge about perceptual and behavioral-physiological correspondence differences during facial matching. Within security settings, our findings may illuminate individual and task-based differences to reduce security risks resulting from undetected fraudulent IDs.

KEYWORDS

Facial Identification / Face Matching / ID Cards / Eye Tracking / Security

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TITLE The Second Face of the Man from Tepexpan

ABSTRACT

The features of an individual's face are the physical qualities that identify them as part of a group with whom they share their biological history. Facial approximation poses the possibility of obtaining an approach to these attributes through a meticulous study of skeletal individualization, knowledge of context, and the use of scientific methods and techniques, as the success of the representation depends on it being as close as possible to the craniofacial structure and consequently achieving a reliable result.

This presentation introduces the second version of the facial approximation of this controversial specimen, and to achieve this, it was necessary to re-examine the sex, age, and additionally the stature of the bone remains. Likewise, the results of the first facial modeling performed by the Austrian-American sculptor Leo Steppat were compared and analyzed with the version presented here.

KEYWORDS

Man from Tepexpan / Facial Approximation / Prehistory of Mexico

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TITLE Forensic Analysis of digital images

ABSTRACT

The Spanish Association of Scientific and Forensic Image works on the application of new techniques of 'Forensic Analysis of Images', based on Data Science and Block-Chain technology in the scientific and forensic environment, establishing the methodology and good practices in this field, to improve the processes of investigation or review of cases and in particular those dealing with missing persons.

It involves the optimization of workflows with evidence characterized by multimedia files and the specialization of forensic expert practice, since currently this dynamic is excessively slow and inefficient. It translates into the speeding up of investigations and inquiries, which are especially decisive in the first hours, especially for cases aimed at locating people. The particular usefulness of these techniques serves to guarantee the veracity and origin of the files on which the investigations are developed, of any of the cases to which the criminal justice system is applicable.

Representatively, we present a model case, in which the improvements during the research for image analysis and the advantages resulting from the application of our methodology in question are appreciated, through: 1- Planning of a workflow based on BlockChain Technology; 2- Identification of Patterns that support or invalidate the integrity and veracity of the images in question, both in their binary structure and in their pixel matrix; 3- Applied to any Criminalistic Techniques report involving the analysis of images as Analysis of Evidence through techniques: such as Forensic Identification, Forensic Thermography and Imaging Diagnosis of the Time of Death and 4- resume of other forensic applications, derived from the analysis of all kind of imaging evidences with this methodology: Bones , Fingerprints, Biological Traces and Marks, Ballistics or Documentoscopy, reconstructions of interior crime scenes and locating buries at exterior scenes by Photogrammetry and/or Scanner/ Drone/Satellite imaging analysis.

KEYWORDS

Forensic / Digital / Image / Analysis / Reports

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TITLE My Face my Rights: Ethical debate about the Revealing Facial Identity of the Dead in Identification

ABSTRACT

Background: In the realm of forensic investigations, the responsibility of identifying an unknown deceased individual falls on the state/authorities, particularly when the body is in an unrecognizable state. The advent of facial recognition technology has significantly transformed this process, enabling the identification of deceased individuals. However, this technological advancement also brings to light several pressing issues, including false positive results, posthumous rights, and consent processes, which demand our attention.

Objectives: This research aims to delve into the ethical issues and social concerns that arise with the use of facial recognition technology in forensic investigations. Specifically, we will examine these issues in the context of data privacy and confidentiality, the consent process, and the dignity of the deceased, using the deontological theory as our guiding framework.

Materials and Method: We explore a few cases in which socio-cultural issues relating to the presentation of the faces of the dead were explored using facial recognition technology in Forensic investigations to raise ethical deliberations.

Result: The ethical situation surrounding facial approximation and public display of the face is complex. Postmortem facial identification, including issues of consent, i.e., who has the right to the body, the deceased, the relative, or the investigation agencies, is a key concern. The potential for a false positive approximation of the deceased, leading to stigmatization if the face resembles a living person, is a significant risk. The technology requires validation, accuracy, and a dialogue to instill societal trust. The authors used ethical deliberation to evaluate facial recognition technology, aiming to strike a balance when revealing the face/identity of the deceased.

Conclusion: Ethical considerations in revealing the face by using facial approximation are complex and multifaceted, requiring careful deliberation and sensitivity. While digital technology offers unprecedented opportunities for memorialization and remembrance, it also demands a heightened awareness of ethical boundaries and cultural norms. Either with consent when a person files any missing cases or by opting out of facial recognition by putting the photographs in the public domain may be a few time being solutions. However, it was also explored that ethical frameworks are needed to help govern postmortem facial image collection, storage and use, ensuring that ethical considerations remain paramount in forensic investigations.

KEYWORDS

Ethical Issues / Consent / Face Identification / Human Remains / Dignity of Dead

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