IACI 2019
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Online Symposium Program

October 2019

Plenary Speaker

Caroline Wilkinson, Liverpool John Moore University (Invited Speaker)
"Cognitive Bias in Relation to Facial Depiction from Human Remains"

Session 1 Standards, Protocols, Resources

1.1 **Carl Stephan**, University of Queensland (Invited Speaker)
"A Principled Overview of Facial Soft Tissue Thicknesses Research in Craniofacial Identification"

1.2 **Rubén Martos**, Oscar Ibáñez, Imaculada Alemán, University of Granada
"A New Atlas of Facial Features for Morphological Analysis Employing Synthetic Facial Images"

1.3 **Sarah Shrimpton**, Caroline Wilkinson, Charlie Frowd, Liverpool John Moores University
"Facial Creation: How Much of a Donor Face Image Can Be Used Whilst Preserving Their Anonymity?"

1.4 **Terrie Simmons-Ehrhardt**, Catyana Falsetti, Anthony Falsetti, Virginia Commonwealth University
"Three-Dimensional (3D) Craniofacial Identification Resources for Quantification, Immersion, and Collaboration"

1.5 **Oscar Ibáñez**, Rubén Martos, Carmen Campomanes-Álvarez, B. Rosario Campomanes-Álvarez, Immaculada Alemán, P.T. Jayaprakash, Horacio Solla, Alexey Abramov, J.M. Alonso, Oscar Cordón, University of Granada
"An Identification Report Template for Linguistic Summarization in Craniofacial Superimposition"

1.6 **Kathryn Smith**, Lorna J. Martin, Wayne Mitten, Caroline Wilkinson, Liverpool John Moores University
"'Extreme Forensics' in South Africa: Exploring New Post-mortem Visual Identification Protocols"

1.7 **Hajime Utsuno**, Chihiro Tanaka, Namiko Ishii, Saki Minegishi, Jun Ota, YosukeMakino, Hisako Saito, Hirotaro Iwase, Koichi Sakurada, Tokyo Medical and Dental University (Invited Speaker)
"Relationship between the Margin of the Piriform Aperture and the Nostril (Preliminary Study)"

1.8 **E Nuzzolese,** M Torreggianti, RG Quaglione, University of Turin
"The Need for a Complete Dental Autopsy of Unidentified Edentulous Human Remains"

1.9 **Chihiro Tanaka,** Hajime Utsuno, Namiko Ishii, Saki Minegishi, Jun Ota, Yosuke Makino, Hisako Saito, Hirotaro Iwase, Koichi Sakurada, Tokyo Medical and Dental University
"Comparison Between a Reconstructed Face and Postmortem Face Using Postmortem CT Images"

Presenting author in bold; presenting author's affiliation.

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Session 2 Age Estimation, Progression

2.1 A Uys, H Bernitz, S Pretorius, **M Steyn**, University of the Witwatersrand (Invited Speaker)
"Age Estimation in Living South Africans"

2.2 **J.P. Meyer**, C. Small, J. Hemingway, Nanette Briers, University of the Witwatersrand
"Facial Age Mapping in Black and Coloured South African Children"

2.3 **Estha Schmidlin**, Maryna Steyn, Tobias MR Houlton, Nanette Briers, University of the Witwatersrand
"Geometric Morphometric Analysis of Age-Associated Facial Shape Changes in South African Adult Males"

2.4 **Ching Yiu Jessica Liu**, Caroline Wilkinson, Liverpool John Moores University
"A Guided Method for Digital Manual Age Progression"

Session 3 Deep Learning, Automation

3.1 **David Urdín,** Pablo Mesejo, Oscar Ibáñez, Andrea Valsecchi, Pierre Guyomarc'h, Hélène Coqueugniot, University of Granada
"Facial Soft Tissue Depth Estimation Using Machine Learning Techniques"

3.2 Enrique Fernandez, **Andrea Valsecchi**, Oscar Ibáñez, Pablo Mesejo, Andalusian Research Institute in Data Science and Computational Intelligence, Panacea Cooperative Research
"Estimating Subject-to-Camera Distance in Facial Images Using Deep Learning"

3.3 **Oscar Gómez,** Pablo Mesejo, Oscar Ibáñez, Andrea Valsecchi, Oscar Cordón, University of Granada, Panacea Cooperative Research
"Towards a Computer-Aided Decision Support System for Comparative Radiography"

3.4 **Guillermo Gomez,** Pablo Mesejo, Oscar Ibañez, Andrea Valsecchi, Oscar Cordón, University of Granada
"Automatic Cephalometric Landmarks Localization Using Deep Convolutional Neural Networks"

3.5 Enrique Bermejo**, Andrea Valsecchi**, Oscar Ibáñez, Pierre Guyomarc'h, Hélène Coqueugniot, University of Granada, Panacea Cooperative Research
"Large-scale Assessment of Landmark-based, Automatic Craniofacial Superimposition for Identification"

3.6 **Diego Terranova**, University of Milano
"A Possible Strategy to Identify the Bodies of Deceased Soldiers in Past Wars"

Session 4 Application of Facial Depictions: Procedures, Public Interaction

4.1 **Maria Castañeyra-Ruiz**, Francesca Phillips, Caroline Wilkinson, Liverpool John Moores University
"The Faces of the Canary Islands: Two Populations that are Centuries Apart"

4.2 **Jorge Molina**, Texas Department of Public Safety
"The Art of Identifying Mansfield, TX Jane Doe"

Presenting author in bold; presenting author's affiliation.

4.3 **Kathryn Smith**, Caroline Wilkinson, Mark Roughley, Sanchita Balachandran, Meg Swaney, Juan R. Garcia, Liverpool John Moores University
"One of Us? Navigating 'Rehumanization' Questions in the Depiction and Display of Two Ancient Egyptians from the Johns Hopkins Archaeological Museum"

4.4 **Rubén Martos,** Oscar Ibáñez, Andrea Valsecchi, Enrique Bermejo, Fernando Navarro, Giedrius Kisielius, Rimantas Jankauskas, University of Granada, Panacea Cooperative Research
"Case Report: Identification of the Leaders of the Anti-Russian Uprisal of 1863-1864 Using Automatic Craniofacial Superimposition Algorithms"

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Online Symposium Abstracts

(Plenary Speaker, then Arranged Alphabetically by Presenter's Last Name)

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Plenary Speaker

Caroline Wilkinson[1,2]

Cognitive Bias in Relation to Facial Depiction from Human Remains

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[2] Face Lab, Liverpool John Moores University

Corresponding Author: Caroline Wilkinson c.m.wilkinson@ljmu.ac.uk

ABSTRACT

This plenary paper explores the thorny subject of cognitive bias in relation to facial depiction from human remains. The speaker will use examples from forensic identification and archaeological investigation to discuss our preconceptions, assumptions, errors and inaccuracies. The ethical challenges associated with facial images of the deceased and their presentation will also be discussed, along with the effects of historical status and judgements of personality and character. Finally the speaker will make suggestions on how to limit cognitive bias and describe the optimal presentation methods for forensic and archaeological depictions.

Biography:

Professor Caroline Wilkinson is the Director of the Liverpool School of Art & Design. She has a background in art and science and her research and creative work sits at the forefront of art-science fusion and includes subjects as diverse as forensic art, human anatomy, medical art, face recognition, forensic science, anthropology, 3D visualisation, digital art and craniofacial identification.

Additionally, Caroline is the Director of the Face Lab, a Liverpool John Moores University (LJMU) research group. The Face Lab carries out forensic/archaeological research and consultancy work which includes craniofacial analysis, facial depiction and forensic art. Face Lab research relates to facial identification, post-mortem decomposition, ancestry determination, craniofacial reconstruction, preserved bodies and facial animation. Face Lab work includes the facial depictions of St Nicolas, Robert the Bruce and Robert Burns.

Caroline is a graduate of the University of Manchester, where she also led the Unit of Art in Medicine 2000-2005 and received a NESTA fellowship to develop a 3D computerised facial reconstruction system for use in forensic and archaeological depiction. She moved to LJMU from the University of Dundee, where she was Head of Human Identification in the award-winning Centre for Anatomy & Human Identification. Her high profile facial depiction work includes facial depictions of Richard III, J.S. Bach and Mary, Queen of Scots.

Caroline is accredited as a forensic anthropologist Level I (craniofacial specialism) by the Royal Anthropological Institute (RAI) and is an experienced forensic practitioner. She has collaborated frequently with museums and the media, especially relating to craniofacial depiction of people from the past. She has worked with the National Museum of Scotland, National Museum of Ireland, Museum of London, Egyptian Museum of Cairo, Theban Mapping Project, FBI Academy, Interpol, Moesgaard Museum, Manchester Museum and the Fraunhofer Institute. She has current research collaborations with Duncan of Jordanstone College of Art & Design, DSTL, Chonnam National University and the Richard III Society.

Keywords: cognitive bias, facial depiction, facial identification

Conflict of Interest Statement: The author declares no conflict of interest.

Presenting author underlined.

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4.1 **Maria Castañeyra-Ruiz[1], Francesca Phillips[1], and Caroline Wilkinson[1]**

The Faces of the Canary Islands: Two populations that are Centuries Apart

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ABSTRACT

This paper is about the ancient population of the Canary Islands. There are 8 islands belonging to Spain, located in the Atlantic Ocean 100 km from the west coast of Morocco. The indigenous population arrived in approximately the 1st millennium AD from north Africa, living in isolation until the 15th century when the Spanish kingdom of Castile conquered the islands. That was the beginning of centuries of the merging of different populations. Nevertheless, DNA studies describing their current population have shown that 42% have Canarian mtDNA lineage of indigenous origin.

In order to explore their connection, Francesca Phillips, a visual artist living in the Canary Islands, has conceived and produced a project called The Quest for Ancestral Faces. The appearance of these earliest inhabitants unknown until now, at Face Lab we have made 50 craniofacial reconstructions of the ancient Canarian population. Francesca has made 50 portraits of the contemporary population. In both cases, the selections capture their diversity.

Both populations have been compared, using averages faces. We have made 4 average faces using 20 images of each face. Comparing by superimposition the images, the ancients faces, and the noses are shorter, wider with square jaws in both sexes than the currents faces.

The contemporaneous faces have lost the epicanthic fold and they present the labionasal crest. They both are very similar in the eyebrows and lips shape.

Nevertheless, even seeing the differences between the average face between the generations, their appearance looks similar in as a distant relative with a European mix during the centuries.

An important aspect of this paper is how the craniofacial reconstructions and the portraits of the current Canarians are viewed. In the exhibition of the same title, a dialogue is created between the juxtaposition of two populations that are centuries apart. By displaying them separately at different ends of the room, they not only confront, but mirror each other.

The exhibition is supplemented by interviews with anthropologists, archaeologists and geneticists specializing in the Canarian populations. This generates a comprehensive view of the heritage of the islands´ people. In summary, due to the exhibition, we can see the strong impact the portraits have in a population's identity, and how new discourse can be created with the depictions of their ancestors, whilst in the middle the visitors feel the passage of time as if they were anthropologists.

Keywords: Canary Islands population, craniofacial depictions, portraits.

Conflict of Interest Statement: The author discloses no financial relationships with commercial entities.

Presenting author underlined.

3.4 **Guillermo Gómez[1], Pablo Mesejo[1,2], Oscar Ibáñez[2,3], Andrea Valsecchi[2,3] Oscar Cordón[1,2]**

Automatic Cephalometric Landmarks Localization using Deep Convolutional Neural Networks

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ABSTRACT

The field of artificial intelligence is living in recent years an extraordinary revolution and popularization. The main milestone of this revolution is a set of techniques called deep learning. These techniques are based on computational models composed of numerous processing layers and used to learn representations with multiple levels of abstraction directly from the input data. Among all possible applications of deep learning to forensic anthropology, this paper deals with the automatic localization of cephalometric landmarks in photographs. This is a problem with important implications in craniofacial superposition and photo-anthropometry (which uses landmarks marked in an image to measure distances between them, and to elaborate proportionality indexes, in order to quantify facial features and proportions). The task of localizing these landmarks is always manually performed, making the whole process extremely subjective (showing a large inter- and intra-expert variability), slow and dependent on the skill, knowledge and experience of the expert forensic. All these elements justify the need to automate the process. Although the automatic location of landmarks is a problem widely studied in the fields of artificial intelligence and computer vision, it has never been applied to the specific case of cephalometric landmarks. For this reason, there are no large datasets available to be used for training. In this paper, we propose a novel framework for cephalometric landmark localization by means of a deep convolutional neural network, where we simultaneously and automatically estimate the position of the landmarks and their visibility. Importantly, the visibility of a particular landmark depends not only on the occlusion (as in conventional facial landmarks) but on the confidence of a forensic expert to safely identify it due to the pose and characteristics of the image. In terms of regression analysis, the pixels corresponding to the image of a person's face would be the independent variables, or predictors, and the Cartesian coordinates of the landmarks would represent the dependent variables. Furthermore, we jointly model the problem as a classification one, by means of introducing a visibility variable per cephalometric landmark. Different approaches for data augmentation and pre-training are compared, and the promising results obtained on a data set containing 164 facial images (under highly variable conditions regarding relative head size, head pose, and image quality) are presented.

Keywords: landmark localization, deep learning, multi-task learning

Conflict of Interest Statement: The author declares no conflict of interest.

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3.3 **Oscar Gómez[1,2], Pablo Mesejo[1,2], Oscar Ibáñez[1,2], Andrea Valsecchi[1,3], Oscar Cordón[1,2]**

Towards a Computer-Aided Decision Support System for Comparative Radiography

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ABSTRACT

Comparative radiography (CR) is a forensic identification technique based on the comparison of the same skeletal structure (such as frontal sinuses, clavicles, or patellae) in ante-mortem (AM) and post-mortem (PM) radiographic data (either X-ray images or CTs) to determine the identity of a deceased person. Several works have tackled the automation of this process using different approaches (such as image registration or geometric morphometrics), but all of them require the manual, time-consuming and error-prone delineation of the skeletal structure's silhouette, i.e. all of them require the manual segmentation of the anatomical structure under study. In this work, we propose an automatic method for segmenting such skeletal structures in radiographic images. Our method takes advantage of some of the most recent advances in deep learning, the branch of machine learning devoted to design computational models composed of multiple processing layers capable of solving complex classification and regression problems directly from data. In particular, we have built our work on deep convolutional neural networks, where only a small set of already segmented radiographs is required to autonomously learn how to segment a new skeletal structure. In our experiments, around 150 images have shown to be sufficient. Different training and architecture simplification strategies have been employed, to deal with larger input images without the need to resort to more expensive and sophisticated multi-GPU scenarios, and to tackle the limited amount of data at our disposal. We have validated our method using chest radiographs from the JSRT and CRASS datasets for the segmentation of clavicles, and with skull radiographs provided by the Hospital de Castilla La Mancha for the segmentation of frontal sinuses. We have obtained promising results in terms of accuracy and robustness while keeping a reduced computational cost. This automatic segmentation framework can be considered as a first step towards a computer-aided decision support system in comparative radiography, where the resulting segmentation is employed in an image registration pipeline as part of the decision making process.

Keywords: comparative radiography, deep learning, image segmentation

Conflict of Interest Statement: The author declares no conflict of interest.

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1.5 **Oscar Ibáñez[1,2], Rubén Martos[1,3], Carmen Campomanes-Álvarez[4], B. Rosario Campomanes-Álvarez[5], Inmaculada Alemán[3], P.T. Jayaprakash[6], Horacio Solla[7], Alexey Abramov[8], J.M. Alonso[9], Oscar Cordón[2,10]**

An Identification Report Template for Linguistic Summarization in Craniofacial Superimposition

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ABSTRACT

Reporting demands lot of time in large variety of professions. In particular, forensic anthropologists are required to concisely fulfil case identification reports as a legal proof of identity. In the case of craniofacial superimposition (CFS) there is a complete absence of a standardize report template and the contents, linguistic terms, images and tables usually included by practitioners in the CFS field vary extremely.

The final goal of this work is two-fold: on the one hand, to provide a complete CFS identification report template. On the other hand, to develop an automatic linguistic summarization system. For the first objective, four experimented anthropologist in the field of CFS (Drs. Alemán, Jayaprakash, Solla and Abramov) have shared their own identification report templates together with forty case reports after removing sensitive data. Other source of important information is related with the international agreements originated within the MEPROCS framework EU project. In particular, those related to the number and specific linguistic terms to be employed to categorize different degrees of matching / confidence. Finally, salient literature related to craniofacial morphological assessment has been considered. The resulting template hierarchically organize the information in the following sections: (1)

Materials; (2) Material Description (Biological Profile, Morphometric and Morphological Description, Facial organs asymmetries); (3) CFS Methodology; (4) Identification Decision (Expert, CFS and SFO Level Decision); (5) SFO Anatomical consistency criterion evaluation; (6) Appendix Tables; and (7) Appendix Images. Next steps would involve the template validation so it can promote to a standard in the field. This way, CFS researchers and practitioners could easily share data in the form of a standardized description of all the interesting material and criteria from a CFS perspective.

Concerning the second objective, the resulting system is expected to make use of the anthropologist's everyday language to provide better understanding for the readers. Additionally, it has to be able to generate reports and summarizations in natural language from both numerical and linguistic data. The approach followed to develop such a system is to adapt a standard natural language generation methodology to generate customized linguistic descriptions of data. Namely, we merge one of the most well-known architectures in the natural language generation research field together with our previous architecture for generating linguistic descriptions of complex phenomena. The latter is supported by the computational theory of perceptions which comes from the fuzzy sets and systems research field.

This abstract corresponds to an open research line. While a first CFS identification report template has been designed, its validation and the development of the linguistic summarization system is still in progress.

Keywords: forensic anthropology, craniofacial identification, craniofacial superimposition, linguistic summarization, identification report template

Conflict of Interest Statement: The author declares no conflict of interest.

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2.4 **Ching Yiu Jessica Liu[1], Caroline Wilkinson[1]**

A Guided Method for Digital Manual Age Progression

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ABSTRACT

To model and predict the possible changes to an ageing face, age progression methods change the shape, colour and texture of a facial image while retaining the identity of the individual. However, the techniques can vary between different practitioners. This study combined the idea of different age progression techniques for under 18s. Connecting research based on longitudinal x-rays from the Bolton standard in 1975; physical anthropometric measurements of the head and face from Farkas and colleagues in 1994; and digital measurements in pixels from Machado and colleagues in 2017. This study documented the workflow of a new method for digital manual age progression using a combination of previously published methods with 12 anthropometric measurements of the face. With an inter-observer error study, two age progressions of the same individual at different ages were generated by three practitioners, and four practitioners participated in the facial measurements of the original image. The proposed age progression method recorded satisfactory levels of repeatability based on the 12 anthropometric measurements (0-9% differences), with facial anthropometric measurements at the Nasion (n) and Trichion (tr) showing the most inaccuracy (13-37% difference between the four practitioners). The two age progressions produced by the three practitioners were compared using manual comparison and machine-based face recognition. The confidence score generated by the Microsoft Face API suggests the performance of an age progression varies between practitioners, where some could lead to a higher confidence score. This study suggests the measurements are able to guide the positioning of the facial features to a certain level, however, the process of age progression remains to be variable with artistic interpretation.

Keywords: facial identification, juvenile age progression, forensic art

Conflict of Interest Statement: The author declares no conflict of interest.

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1.2 **Rubén Martos[1,2], Oscar Ibáñez[2,3], Imaculada Alemán[1]**

A New Atlas of Facial Features for Morphological Analysis Employing Synthetic Facial Images

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ABSTRACT

Morphological analysis, one of the approaches in facial comparison, is a systematic method in which the features of a face are described and then compared between an image and a suspect or between sets of images. These features include a global description of the face, a posterior local description of the anatomical structures (nose, eyes, mouth, etc.) and discriminating characteristics (scars or moles) of an individual. When a systematic method of morphological analysis is applied, the conclusions are based on a subjective assessment and interpretation of the similarities and differences observed. Although some authors have proposed a classification scheme for facial features, a standard agreement has not been reached within the scientific community. Other studies, in an attempt to promote standardization in the procedure of photo identification, show that when a fixed classification schema (like an atlas) is given to the experts, inter observer differences in classification of facial features are still present. All the studies in this field indicate the difficulty of classifying individual features.

Alternatively to atlas based proposals where a few examples of facial features are given, we propose the use of synthetic facial images. In particular, we have used “Makehuman”, a software specifically designed for the modelling of virtual humans, with a simple yet complete system including the simulation of muscular movement. Employing this software we have developed a concise guide for morphological labelling with a set of 39 facial criteria, modelling all of them in a progressive scale (with 11 examples per criteria) including “normal” appearances and both deviation extremes. We have set-up inter- and intra-observer studies in which we have created a simulated scenario with 3D facial models of which we know the real value (numerical weights in Makehuman software) assigned to all the facial features evaluated. Then, we ask the participants to match the criteria observed in the image with the most similar example of the guide, which has been assigned with a previous value to subsequently compare it with the ground truth. For the first time, in this work we have developed a methodology to directly compare the results obtained of an observer with the real data for a set of facial criteria. This allows us to determine which criteria are more objective and which are more discriminative. In our previous pilot study (and similar to the conclusions achieved in the related scientific literature), following the traditional methodology, we obtained several discrepancies between the participants and a high inter-expert variability. Now, with this new approach, promising results has been obtained in a first pilot study, with low inter-expert variability and a high precision (around 80%).

Keywords: facial morphology, facial comparison, Makehuman

Conflict of Interest Statement: The author declares no conflict of interest.

Presenting author underlined.

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4.4 **Rubén Martos[1,2], Oscar Ibáñez[2,3], Andrea Valsecchi[2,3,4], Enrique Bermejo[3,4], Fernando Navarro[1], Giedrius Kisielius[5], Rimantas Jankauskas[6]**

Case Report: Identification of the Leaders of the Anti-Russian Uprisal of 1863-1864 using Automatic Craniofacial Superimposition Algorithms

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ABSTRACT

At the beginning of 2017, human remains were uncovered at the Upper Castle of Vilnius. As archaeological artefacts confirmed historical data that these might be clandestine inhumations of 21 executed leaders of the anti-Russian uprisal of 1863-1864, systematic archaeological excavations together with historical and forensic anthropological investigations with identification purpose for subsequent state reburial were started. During 2017-2018, 20 human remains in 14 inhumation pits were uncovered. Subsequent identification process included analysis of cross-matching of post-mortem (PM) data: burial artefacts, age, stature, signs of execution (hanging or fusilade), antemortem lesions, with ante-mortem (AM): date and mode of execution, age and other data from historical files. Genealogic search for live and dead relatives was performed, and genetic identification (comparing data of individuals from the site and samples taken from exhumations of relative graves using next generation sequencing) was performed.

In parallel, as photographs of 10 individuals were available, craniofacial superimposition was performed. This additional identification method has been applied by three inexperienced craniofacial identification researchers (Drs. Kisielius, Navarro and Mr. Martos), different to those working over all AM and PM data (team led by Dr. Jankauskas). Indeed, they only had access to the anthropological profile information (sex and age), the 3D scanned skulls of 18 out of the 20 human remains (two of them were lost during former earthwork) and 11 photographs of ten different candidates. To tackle the ten AM cases vs 18 PM cases cross-comparison problem they made use of Skeleton-IDTM 0.7.0-alpha1 version, software developed by Panacea Cooperative Research. They have followed the agreements of MEPROCS EU project as a methodological approach. This way, a blind validation of both the methodological framework and best practices defined by MEPROCS consortium has been carried out on a real identification case report. For the first time, information provided by a series of automatic algorithms based on Artificial Intelligence (skull-face overlay and decision support system) has been considered within the decision making process led independently by the three anthropologists.

This abstract corresponds to a work in progress research. Thus, final results and corresponding analysis will be provided within the framework of the IACI-19 conference.

Keywords: forensic anthropology, craniofacial identification, craniofacial superimposition, Skeleton-ID, artificial intelligence

Conflict of Interest Statement: The author declares no conflict of interest.

Presenting author underlined.

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2.2 **J.P. Meyer[1], C. Small[1], J. Hemmingway[1], N. Briers[1]**

Facial Age Mapping in Black and Coloured South African Children

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ABSTRACT

Despite substantial provisions by legislation, children in South Africa suffer disproportionally high levels of violence. Forensic experts are becoming more involved with investigations regarding trafficked children, child-prostitution, and missing children. These cases are often complicated due to photographic material being the only available evidence. This highlights the importance of developing methods that will aid in the accurate identification and age estimation of children from 2D images. Therefore, this study investigated differences in anterior craniofacial shape among 6, 10, and 13-year-old South African children of different sex and ancestry using geometric morphometrics (GM). Additionally, visual representations of the average face-shape of each group were constructed using FantaMorph, which could serve as reference models to assist in forensic cases where facial depictions are required. The anterior facial shape data collected were used to estimate age within the various age groups of the sample. The sample consisted of 360 anterior facial photographs of Black and Coloured South African children in the age groups 6, 10, and 13-years. The photographs were all taken under standardised conditions by a single researcher. Twenty-one facial landmarks were digitised on each image using tpsDig. Principal component analysis, canonical variate analysis (CVA), and discriminant function analysis (DFA) were conducted on the landmark data using MorphoJ. CV1 accounted for 80.2% of the shape variation in terms of age, sex and ancestry in the Black sample, but only 73.9% in the Coloured sample. The differences in variation were primarily due to differences in the mandibular and midfacial regions. DFA performed on the landmark data achieved age estimation accuracies of 95.6% in the Black sample and 74.2% in the Coloured sample. With regard to facial shape, analysis of the data indicated that these two population groups experience growth and development very differently from one another and thus highlights the ancestral and anthropological diversity that exists within South African communities. The results of this study showed that GM and DFA of facial shape data can be used as a method for age estimation in living children from 2D images.

Keywords: geometric morphometrics, age estimation, face shape

Conflict of Interest Statement: The author discloses no financial relationships with commercial entities.

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4.2 **Jorge Molina**[1]

The Art of Identifying Mansfield, TX Jane Doe

Affiliation: [1] Texas Department of Public Safety / Texas Rangers

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ABSTRACT

This poster presentation will outline the procedural techniques employed by a Texas Ranger Forensic Artist in the development of a facial reconstruction or approximation that led to the identification of a cold case murder victim. The poster will showcase both two and three-dimensional digital imaging techniques and as well document standard protocols for the investigation of such cases.

In June of 2017, Forensic Artist Jorge Molina started work on a facial reconstruction from unidentified human remains at the request of the Mansfield Police Department and the Tarrant County Medical Examiner's Office. The skeletal remains were found in 2015 and an investigation revealed that the victim was an African-American woman anywhere between 5'2" and 5'10" and somewhere between 35 and 55-years-old at the time of her death. The case remained open despite the exhaustive efforts of the Mansfield Police Department (MPD) to resolve the investigation. In 2017, MPD detectives appealed to the Texas Rangers Unsolved Crimes Investigations Program (UCIP) to further the investigation. The UCIP team referred MPD to Texas Ranger Forensic Artist Jorge Molina to request a forensic facial reconstruction. Artist Molina requisitioned the evidentiary remains and forensic anthropological analysis.

Using the forensic anthropology, the evidentiary skull, case-specific research, and accepted forensic art techniques, Artist Molina developed a 2-D facial reconstruction of the decedent. An image illustrating a superimposition of the skull within the reconstruction was created to illustrate the correspondence between the contours of the face and the distal points of the tissue depth markers.

Additionally, three-dimensional scanning technology was implemented in this case as an efficient means of documenting and archiving the cranial data. Artist Molina then used the point cloud data to generate a three-dimensional virtual model of the evidentiary skull using a combination of three separate modeling applications (Autodesk 3ds Max, Pixilogic ZBrush, and Adobe Photoshop).

A press release was scheduled for mid-August 2017. The facial reconstruction images were distributed to various media outlets and a viable lead was developed. In January of 2018, the identity of the victim was confirmed via DNA analysis.

Keywords: facial reconstruction, approximation, forensic art

Conflict of Interest Statement: The author declares no conflict of interest.

Presenting author underlined.

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1.8 E. Nuzzolese[1], M. Torreggianti[2], G.R. Quaglione[3]

The Need for a Complete Dental Autopsy of Unidentified Edentulous Human Remains

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ABSTRACT

The scientific literature in the field of forensic human identification highlights the importance of a multidisciplinary approach with primary and secondary identifiers, including post mortem dental data collection.

This presentation will provide the results of an identification casework in which the dental autopsy and dental radiology were beneficial in the postmortem data collection of an edentulous individual.

In December 2017 a decomposed unidentified body was found near the river Tronto of Teramo (Italy), without any identifying document or specific personal belongings, except for a packet of cigarettes. After the autopsy performed by the medical examiner, the Penal Court in Teramo (Italy) appointed two forensic odontologists to complete the post mortem assessment and collect dental data for the purpose of identification.

The complete dental autopsy with 43 pericapical X-Ray images allowed the definition of a dental biography of a male aged between 55 and 65 years old, totally edentulous with an upper and a lower denture and an osteosynthesis with two plates and screws in the left corner of the mandible. The generic profile was circulated by the Carabinieri Police Agency and sent also to regional association of missing persons, and to the editorial team of a national TV program on missing persons.

In March 2018 the sister of the missing person finally reported the disappearance of her brother and a presumptive identification was performed through a visual recognition of the decomposed cadaver. The sister confirmed the presence of two dentures, revealing the name of the dentist and the place of the maxillo-facial surgery for the treatment of the fractured mandible.

Forensic odontology was able to establish the identity of the cadaver by comparing the dental and radiological data received from the dentist and the hospital, and no DNA comparison was required.

This case report confirms the need to apply Interpol standards when performing human identification. A complete dental autopsy inclusive of oral X-ray imaging should always be performed, even when unidentified human remains are edentulous or with no teeth clinically visible.

Keywords: human identification, edentulous, dental autopsy

Conflict of Interest Statement: The author declares no conflict of interest.

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2.3 **Estha Schmidlin[1], Maryna Steyn[1], Tobias MR Houlton[1], Nanette Briers[1]**

Geometric Morphometric Analysis of Age-Associated Facial Shape Changes in South African Adult Males

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ABSTRACT

Little research has been conducted regarding age related facial shape changes in Africans. Differences between complex shapes, such as the face, have been successfully assessed using geometric morphometrics (GM). This study applies GM to analyse facial ageing in South African adults. The sample comprised of standardized 2D facial images (n=189) of individuals aged 20 years and older. Images were digitized and relative warp frames based on Procrustes superimposition were constructed using the tps software package. GM analysis was conducted using MorphoJ software. Deformation wire frames provided insight on facial transformation for each subsequent age decade. Principle component analysis, discriminant function analysis and canonical variate analysis were performed in MorphoJ. These analyses assessed the relative contribution of areas of the face to overall senescence, the variation between facial shapes in age groups and the degree to which age groups can be successfully differentiated based on facial shape. Results indicated large areas of overlap for age related shape changes, with older age groups showing greater variance compared to younger individuals. The first five principle components for the entire sample pooled by age group account for more than 85% of within-group shape variance in anterior images, with major facial changes for each including: downward displacement of ears and nose; upward displacement of eyes and mouth; shorter and wider facial outline; narrowed cheeks and forehead with ears laterally displaced. The first five principle components for lateral images account for just over 70% of variance, with clear changes including: forward displacement of the facial profile; narrowing of the distance between forehead and hairline; backward displacement of nose and mouth; downward displacement of facial profile; forward displacement of nose and mouth, accompanied by receding hairline. Discriminant function scores show little overlap between groups, and cross-validation indicated that most age groups can be successfully differentiated for both sets of images. The first three canonical variates account for more than 82% in anterior, and just less than 80% of among-group variance in lateral images - indicating clear differences between age groups. This study provides a novel analysis of facial changes in South Africans with increasing age. It is envisioned that this research may assist in increasing the accuracy of facial depictions as well as facial image ageing in a forensic context.

Keywords: South African males, facial ageing, geometric morphometrics

Conflict of Interest Statement: The author declares no conflict of interest.

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1.3 **Sarah L. Shrimpton[1], Caroline M. Wilkinson[1], Charlie Frowd[2]**

Facial Creation: How Much of a Donor Face Image can be used whilst Still Preserving their Anonymity?

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ABSTRACT

Synthetic, or created, faces can emerge out of the compositing of other facial features/parts, particularly in forensic facial identifications scenarios. Sampling features, for their shape, texture, or both, makes use of existing anatomy so that the synthetic face can be constructed in an anatomically plausible way. However, the resulting synthetic face can end up appearing similar to the donor face(s) from which features/parts were sampled. These resulting similarities are even more likely given that donor faces are chosen based on their similarity to the planned synthetic face. In some cases it is also possible that multiple features are sampled from one donor face to allow for consistent lighting, resolution, pigmentation, age, etc., resulting in even more similar looking faces. This becomes a problem when donor faces wish to remain anonymous or when face images are sampled from the internet. Furthermore, the circumstances of the context in which the synthetic face is to behave, e.g. forensic facial depiction, may further complicate the matter by generating an unwanted association.

A previous study by the researchers demonstrated that replacing (compositing) one facial feature on a known face (celebrities and lecturers) with an unknown feature was, as expected, not sufficient to render that face unrecognisable, suggesting considerable further modifications of a known face (donor) need to be made. A second study, presented here, replaced features (eyes, eyebrows, nose, mouth, hair and facial outline) in an incremental fashion to test for any criterion point when a known face (n=39) might be perceived as a new synthetic face. Participants (n=162) were asked to name the altered face images in an online study.

As expected, an ordinal decrease in recognition was observed as features were gradually replaced on the known faces. Results revealed a significant drop in recognition rates once at least two features in the face had been replaced ($p < .05$). Further feature replacement was paired, suggesting that replacement of one feature makes little difference, in comparison to two. Which feature is being replaced only becomes important when half the features have already been replaced; replacing the upper half of the face resulted in significantly lower recognition compared to the lower half (celebrities only). Therefore, as a guide, if anonymity of a donor is to be preserved, no more than half of any one donor face should be used to generate a synthetic face. Additional modifications to the features/parts should also be considered.

Keywords: face recognition, face databases, compositing

Conflict of Interest Statement: The author declares no conflict of interest.

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1.4 **Terrie Simmons-Ehrhardt[1], Catyana Falsetti[2], Anthony Falsetti[2]**

Three-dimensional (3D) Craniofacial Identification Resources for Quantification, Immersion, and Collaboration

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ABSTRACT

Computed tomography (CT) scans offer a unique opportunity for craniofacial identification researchers and practitioners to visualize and quantify precise anatomical correspondences between soft-tissue facial features and the craniofacial skeleton. Given the increasing availability of de-identified CT scans and the abundance of free tools for rendering and analysis, a suite of tools and workflows was developed by the author to facilitate collaboration between researchers and practitioners and increase access to common reference resources. Stereolithography (STL) models of head CT scans were generated for landmark collection and for sharing with a facial approximation practitioner for recording of qualitative observations. The STL models were transformed to a common position and orientation with reference to Frankfurt Horizontal, so that multiple models could be viewed simultaneously within the same 3D space and in appropriate frontal or profile views. The STL models can be 3D printed, and we have presented workflows for creating custom reference prints with 3DSlicer and Meshmixer. Given the common orientation and position, the landmarks have been used to calculate relative landmark positions, distances, intersections, and angles in 2D and 3D and are therefore translatable to 2D and 3D methods of facial approximation and craniofacial superimposition.

A workflow for generating dense facial tissue depth maps (FTDMs) in Meshlab has been published, along with scripting to “split” FTDMs into depth increments to allow viewing of similar depths across multiple individuals. FTDMs are PLY models with depth values encoded and colorized on an RGB scale from thinnest to thickest, providing an intuitive visual presentation of depth distributions within one individual as well as among individuals and will facilitate the development of tissue depth prediction methods. To encourage practitioner immersion and interaction with the 3D models, we have built a custom HTML/CSS/javascript software based on the 3DHOP platform, containing a visual index of skulls that link to 3D viewers containing face and skull models with a minimal set of interactive tools, such as transparency, measurement, lighting, and clipping. The HTML files open in a web browser and are compatible with the software R Shiny, enabling the future incorporation of analytical tools. The resources and workflows we currently share online via blog tutorials and Figshare can be applied to any head CT data. Further, the application of free and web-compatible tools to generate 3D craniofacial resources will improve access to common data sources for research and practitioner training and facilitate collaboration on an international level.

Keywords: 3D, computed tomography, dense facial tissue depth maps

Conflict of Interest Statement: The author declares no conflict of interest.

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1.6 Kathryn Smith[1], Lorna J. Martin[2], Wayne Mitten[3] and Caroline Wilkinson[1]

'Extreme Forensics' in South Africa: Exploring New Post-Mortem Visual Identification Protocols

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ABSTRACT

Being identified in death is recognized as a basic human right, and has significant legal, social and cultural implications. Yet increasingly, narratives about unidentified deaths are reaching us via the media, either the result of a single-event mass fatality, or undocumented border-crossings occurring over time.

In September 2016, a South African Police Service (SAPS) National Order placed new focus on South Africa's crisis of unidentified and unclaimed dead 'buried without proper investigation' (est. 10,000 pa). In South Africa, the mandate for the Forensic Pathology Service (FPS) lies with the Provincial Departments of Health, and legal identification is the mandate of the South African Police Service (SAPS). Forensic Art (craniofacial reconstruction, post-mortem depiction, craniofacial superimposition and age progression) is a service provided by the SAPS Victim Identification Centre (VIC). Bodies may only be released from FPS facilities when proof of legal identification is met. After 30 days, they may be legally disposed of. 'Proper investigation' therefore requires co-operation between these services.

Informed by the growing field of Forensic Humanitarian Action (FHA), and adopting a multimodal, participant-observer methodology, this presentation reports on one aspect of a broader PhD study which anticipated, and paralleled, the events described above.

In partnership with FPS Salt River, central Cape Town's busiest medico-legal mortuary (> 4000 cases pa), a records review of unidentified cases over a 7.5-year period (n = 1010) was carried out to assess the quality of the facility's post-mortem facial photography and its suitability for post-mortem depiction (image sanitization). A focus group (n = 15 FPS forensic officers) generated qualitative data to assess cross-cultural responses to an array of post-mortem depictions by a selection of recognised forensic artists working in various styles and media. Semi-structured interviews (n = 15) were carried out with Salt River senior management, SAPS VIC members, and consulting forensic anthropologists and pathologists at three academic institutions, providing context and history for post-mortem identification procedures in the South African context.

Findings indicate that the crisis is a result of complex and intersecting factors. Where the National Order reiterated existing protocols for post-mortem identification, this study goes significantly further, suggesting that an improved status quo will demand fundamental changes to standard operating procedures and infrastructure within and between both services, focused on a significant investment in secondary methods of identification, namely the expansion of forensic facial depiction services, supported by a managed, public-access database.

Keywords: forensic identification, post-mortem depiction, operational policy

Conflict of Interest Statement: The author declares no conflict of interest.

Presenting author underlined.

4.3 **Kathryn Smith[1], Caroline Wilkinson[1], Mark Roughley[1], Sanchita Balachandran[2], Meg Swaney[2] and Juan R. Garcia[2]**

One of Us? Navigating 'Rehumanisation' Questions in the Depiction and Display of Two Ancient Egyptians from the Johns Hopkins Archaeological Museum

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ABSTRACT

This poster presents how innovative scientific and curatorial approaches have figured in attempts to 'rehumanise' two ancient Egyptian individuals for display at Johns Hopkins Archaeological Museum, whilst encouraging critical interrogation of how knowledge is constructed and disseminated at the interface of art and science.

Responsible and respectful stewardship of human remains held in museum collections (particularly archaeological and 'natural history' institutions) has demanded close attention in recent years, particularly in the context of repatriation claims. But what of human remains for which there is little or no demand for repatriation, and which lend themselves to highly aesthetic treatment, as in the case with Ancient Egyptian material culture, including mummies? Conventions of trading, collecting and displaying such material undoubtedly contributes to their conceptual transformation from 'human subject' to 'museum object', crafting a critical distance between the body as individual, and cultural commodity.

Seeking to reverse this distinction, we focus on the process of producing facial depictions of two ancient Egyptian individuals who have been closely associated with the history of Johns Hopkins University since the early twentieth century. Carried out by LJMU's Face Lab in close consultation with an interdisciplinary team at Johns Hopkins, the depictions were based on CT scan data, with 3D craniofacial reconstructions produced in Geomagic Freeform, and finally presented as 2D images textured in Adobe Photoshop. The depictions contributed to an extensive multimodal and conservation-driven study of these two individuals and their associated objects, the results of which include a reassessment of biological sex for one individual as well as a probable name, which now replaces the previous catalogue reference to the collector-patron who gifted her remains to the museum.

Reflecting on how curatorial decisions shape the visitor experience present an opportunity to critically assess the presentation of craniofacial reconstructions in museums. Specifically, we consider the presumptions of 'non-invasive' scientific technology and digital imaging, asking what might be at stake, for exhibition makers and visitors alike, in projecting contemporary ideas, including cognitive biases, onto past people?

Keywords: craniofacial reconstruction, rehumanization, museums

Conflict of Interest Statement: The author declares no conflict of interest.

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1.1 Carl N. Stephan[1]

A Principled Overview of Facial Soft Tissue Thicknesses Research in Craniofacial Identification

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ABSTRACT

The distance from the skull to the facial surface can be quantified by simple linear measurements termed facial soft tissue thicknesses (FSTT). These numerical distances have long been heralded as the scientific backbone of craniofacial identification methods in part due to their systematic derivation. First collected in 1883 on a small sample of 13 subjects, the literature now abounds with more than 169,000 measurements taken from over 18,800 individuals across >100 FSTT studies. This volume of data collected over a substantial timeframe (136 years so far) with extensive time and resource commitment makes it pertinent to ask: (1) what key lessons have been learnt; (2) what advances have been made; (3) what standardization has been achieved; (4) has casework success been improved as a result of this new knowledge; (5) what remaining gaps require redress; and (6) where is the current research trajectory taking the field? These questions not only place the long history of prior FSTT research in context, but they set an important checkpoint on the way to improved craniofacial identification methods, since new research findings additionally set new minimum standards for future research. This presentation will explore each of the above 6 criteria and their resulting minimum standards for future research.

Keywords: craniofacial identification, facial soft tissue depth, facial soft tissue thickness

Conflict of Interest Statement: The author declares no conflict of interest.

2.1 A Uys[1], H Bernitz[1], S Pretorius[2], M Steyn[3]

Age Estimation in Living South Africans

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ABSTRACT

Age estimation in living individuals around the legal age of 18 years remains a difficult but highly relevant challenge, with limited options available. In this study third molar development was used, along with the novel method of anterior inferior vertebral ring apophysis development, to assess the age of living individuals and the probability of being 18 years. For third molar development, panoramic radiographs of 705 white and 563 black South Africans were scored using a 10 stage scoring system. Vertebral apophysis development of C2, C3, and C4 of 496 white and 478 black South Africans were assessed from cephalometric radiographs, using a newly developed four-stage scoring system. All individuals were aged between 15 and 25 years. Likelihood values were determined for individuals in each sex and population group being 18 years, based on developmental stages. For apophysis development, the median ages for attainment of stages 0, 1, and 2 were below the 18-year threshold for all ancestry and sex groups, while stage 3 was also below this threshold in some groups. Black individuals consistently matured earlier than white individuals as far as third molar development was concerned, while for most of the stages the opposite was true for vertebral apophysis development. Differences between the sexes were also noted for molar, but not for vertebral apophysis development. These results show that cervical vertebral apophysis development is a valuable, novel addition to the assessment of age in living individuals, and these two methods now need to be combined in a statistical model to enhance our capability to determine the probability that an individual is over or under the 18-year threshold. Both these methods are easy to use, repeatable, and can be assessed from standard and routinely used radiographic images. The developed models need to be sex and ancestry specific, as clear differences were noted.

Keywords: vertebral ring apophysis, third molar, maturation

Conflict of Interest Statement: The author declares no conflict of interest.

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1.9 Chihiro Tanaka[1], Hajime Utsuno[1], Namiko Ishii[1], Saki Minegishi[1], Jun Ota[1], Yosuke Makino[2,3], Hisako Saito[3], Hirotaro Iwase[2,3], Koichi Sakurada[1]

Comparison Between a Reconstructed Face and Postmortem Face using Postmortem CT Images

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ABSTRACT

Forensic facial approximation is a technique used to identify unknown human skeletal remains. In the recent years, many researchers have reported prediction and estimation methods identifying the position of external acoustic meatus, pupil and orbit, nose and nasal aperture, and lips and teeth. However, these regions are relatively difficult to identify because of their soft tissue structures, which include only cartilage or facial muscle. The authors attempt to estimate the accuracy of resemblance between the real face and the reconstructed face using a Japanese method published by the corresponding author. The author used the postmortem CT images (PMCT) of forensic cases (autopsy cases) from Department of Legal Medicine, University of Tokyo. Extracted skull image was obtained and printed-out by a 3D printer. After an investigation (of facial profile, etc.) by the corresponding author, faces were reconstructed on the printed skull and compared and assessed with the postmortem face (death mask).

Materials and method

Samples were obtained from PMCT images with minimum postmortem changes from the Department of Legal Medicine (1 male and 1 female). PMCT images were managed by OSIRIX MD. Skulls were extracted on software and landmarks were plotted on it to measure the width, height, and depth for recognizing the difference between images and printed skull. On software, skull images were converted from DICOM file format to STL file format. After converting to STL, the files were installed to a 3D printer and printed out. The 3D skull was scanned by a 3D scanner, and anterior and lateral view photographs were taken by a digital camera for the assessment of facial profile. The reconstructed face was built on the 3D skull using the Gerasimov's method and Japanese facial profile analysis. The reconstructed face was compared with the postmortem face.

Result

Positive results were observed in the resemblance between the reconstructed face and death mask.

Keywords: facial approximation, facial reconstruction, postmortem CT images

Conflict of Interest Statement: The author declares no conflict of interest.

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3.6 Diego Terranova[1]

A Proposal for an Automated Protocol for the Identification of Killed in War Soldiers.

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ABSTRACT

The military campaign of Italy against Russia in 1941-42 caused the death of about 75,000 soldiers, part of which declared missing in action. Cause the recent agreements between Italy and Russia various mass graves (the principal in Kirov region) are in these days digged up, and many italian volunteers participate in these operations. Two or three times in a year groups of bodies of deceased italian soldiers return in their homeland, but only a part of them are recognized thanks of their metal platelets: the majority remain unidentified. The problem of Italy (in the knowledge of the author this problem concerns all countries) is the lack of a complete DNA database of italian families, so DNA comparisons are not possible between skeletons of deceased soldiers and the large group of potential relatives. Many relatives of the deceased soldiers are reunited in an association (UNIRR – www.unirr.it - Unione Nazionale Italiana Reduci Di Russia), and a database of photos (about 9000) of the deceased exists (www.unirr.it/gallerie-immagini/caduti-dispersi-e-morti-in-prigionia). Recently a method of comparison of the location of landmarks in faces and skulls has been proposed: the method, which has given good results, has been tested on volunteers (comparison of face and skull radiography): the same method could be used for the identification of deceased soldiers, but with the complication of the necessity to match a skull with a large number of face photos. So there is the necessity of a procedure automatically assigning to a just digged up skull a group of potential matches drawn from the photos database: after this first step an historical investigation could follow (where and when the deceased in a photo resulted missing in action? Where the skeleton has been found?). The final step should be a DNA test..

Keywords: automated facial comparison, identification, cranial landmarks

Conflict of Interest Statement: The author declares no conflict of interest.

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3.1 **David Urdín[1], Pablo Mesejo[1,2], Oscar Ibañez[2,3], Andrea Valsecchi[2,3], Pierre Guyomarc'h[4], Hélène Coqueugniot[5,6,7]**

Facial Soft Tissue Depth Estimation using Machine Learning Techniques

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ABSTRACT

The facial soft tissue depth (FSTD) is a relevant measure in facial reconstruction and craniofacial superimposition, and it is used to estimate the position of facial landmarks from the corresponding landmarks on the skull. When tackling craniofacial superimposition as a craniofacial landmarks matching problem, the FSTD is traditionally calculated as the average depth per landmark from a certain sample of a particular population. In this paper, we propose to avoid the mere use of this average, and substitute this strategy by the regression of a series of 3D landmarks on the face from 3D landmarks on the skull, in order to estimate the thickness of the soft tissue that separates the skull from the face for each particular individual. We employed the data acquired by Guyomarc'h et al. ("Facial soft tissue depths in French adults: variability, specificity and estimation", Forensic science international, 2013). This database includes 61 cranial and 83 facial landmarks of 500 individuals, along with their sex and age. The problem tackled in this paper is extremely challenging because of the reduced number of available data (which limits the amount of training examples); the large number of missing values (either because there is no corresponding landmark on the face, because the corresponding one cannot be reliably located in a photograph, or because the scan does not capture the skull area or the details that allow to locate it); the lack of an initial alignment of the skulls (so the available data are not directly comparable and usable); or the absence of a clear consensus in the scientific community about acquiring and labeling the landmarks, among other issues. In terms of regression analysis, the landmarks in the skull would be the independent variables, or predictors, and since the final objective is the estimation of the soft tissue, the landmarks on the face or the thickness itself would represent the dependent variables. Different regression methods are compared (linear regression, multilayer perceptron, random forest, support vector machines, and partial least squares), and both the benefits of using imputation techniques for the missing values and the impact of adding additional landmarks are studied.

Keywords: facial soft tissue depth, regression problems, machine learning

Conflict of Interest Statement: The author declares no conflict of interest.

Presenting author underlined.

1.7 **Hajime Utsuno[1], Chihiro Tanaka[1], Namiko Ishii[1], Saki Minegishi[1], Jun Ota[1], Yosuke Makino[2,3], Hisako Saito[3], Hirotaro Iwase[2,3], Koichi Sakurada[1]**

Relationship Between the Margin of the Piriform Aperture and the Nostril (Preliminary Study)

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ABSTRACT

Forensic facial approximation is a technique used to identify unknown human skeletal remains to estimate a victim's antemortem face. Initially, the sex, age, ancestry, etc. of the skull are estimated by forensic anthropologists. From these, forensic anthropologists plan the framework of the estimated facial profile. In this process, the framework is designed based on the mean facial soft tissue thickness (FST). In the next step, forensic artists start to build the face.

However, FST is used only for the regions that are lined by bone. It is difficult to apply FST for the ear, eye, nose, and lip regions because of their variance. The nasolabial fold is the bordering landmark and structure between the upper lip and nose or cheek region. This fold changes significantly with age. In this study, the author observed and estimated the morphological relationship between the margins of the piriform aperture and the nasolabial fold using postmortem computed tomography (PMCT) images for autopsy. PMCT images were collected from Department of Forensic Medicine, University of Tokyo and Department of Legal Medicine, University of Chiba. In the sample, a large trauma was in the face and head region, and decomposed, drowned, burned, mummified, and over 48 hours after death cadavers were excluded. PMCT images were handled on the OSIRIX MD software. Forty-five samples (25 male and 20 female; age: 20~55 years old) were measured. We plotted 10 landmarks on the bone and 8 landmarks on soft tissue surfaces. Then, we plotted and measured the distances between the bony landmarks. Additionally, the angle between the nasolabial fold and FHP was measured. The ratio was observed, and the maximum and minimum width of piriform aperture was measured on the skull. The width of the nostrils and the superior end of the nostrils were measured. Obtained measurements were analyzed using Microsoft Excel and GraphPad Prism. The relationship between skull and soft tissues were observed in these measurements.

Keywords: facial approximation, facial reconstruction, nostril

Conflict of Interest Statement: The author declares no conflict of interest.

3.5 **Enrique Bermejo[1,2], Andrea Valsecchi[2,3], Oscar Ibañez[2,3], Pierre Guyomarc'h[4], Hélène Coqueugniote,[6,7]**

Large-Scale Assessment of Landmark-Based, Automatic Craniofacial Superimposition for Identification

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ABSTRACT

In the context of craniofacial superimposition, the task of superimposing a skull over a photo matching the pose of the face is known as skull-face overlay (SFO). Several computerized methods for SFO have been proposed in the last few years. After a forensic analyst has located corresponding landmarks in the photo and on the skull, these methods are able to create a SFO automatically. However, present SFO methods are based exclusively on landmarks. That is, with these algorithms, the skull is superimposed over the facial image so that corresponding cranial and facial landmarks are as close as possible. The average distance between matching landmarks is actually used inside the algorithm to measure the quality of the superimposition. Whenever this "superimposed landmark distance" (SLD) is small, the algorithm considers that the superimposition is good, and vice versa, regardless of any other anatomical consideration. This assessment criterion, while definitively very limited, turned out to be very effective in practice, striking a balance between simplicity and correctness.

This fact leads to the following questions: is SLD effective for comparing superimpositions of different skulls? If so, can we even identify a missing person by performing SFO and simply measuring the SLD? Can we at least exclude some candidates in a multiple comparison? This study is the first step towards answering these questions empirically. The scenario of our experiments is that of multiple comparison using CFS. We have collected a large set of data and performed a massive amount of automatic SFOs, measured the corresponding SLD and ranked the candidates accordingly. This allowed us to assess quantitatively the effectiveness of this method for shortlisting. Also, we investigated the role played by a number of factors such as the pose of the head in the photo, the number of landmarks available and the accuracy in the localization of the landmarks.

Keywords: craniofacial superimposition, facial identification, multiple comparison

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Estimating Subject-to-Camera Distance in Facial Images using Deep Learning.

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ABSTRACT

The analysis of facial images is affected by the pose of the head of the subject being depicted, with some techniques being applicable or effective only for a certain range of poses, such as the loosely- defined class of frontal photographs. Automatic head pose estimation has been investigated extensively, to the point that several methods based on Deep Learning have even outperformed human analysts in this task. A related problem is the estimation of the distance between the subject and the camera. This subject-to-camera distance (SCD) determines whether the depiction of the face in the photo is affected by a significant amount of perspective distortion, the lack of which is another requirement of most facial analysis techniques. Also, whenever the focal length of the camera lens is known, which is not uncommon in digital images, knowing the SCD allows for the conversion of measurements taken on the photograph to actual, physical measurements of the face of the subject. Finally, in the context of craniofacial superimposition, knowing head pose, SCD and the focal length is essentially all the information required to perform an automatic face-skull overlay.

SCD is thus a key piece of information in facial image analysis. In this paper, we investigate the use of Deep convolutional neural networks for the automatic estimation of the SCD. As deep learning methods require very large sets of annotated data to be effective, we employed a method to simulate facial images from 3D facial scans. Thirty subjects were scanned eight times while display different facial expressions. From these scans, we obtained a corpus of tens of thousands of images used to train and test our algorithm.

Keywords: facial image analysis, deep learning, craniofacial superimposition

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