B1 Experimental Analysis of the Changes in Pre- and Post-Operative Cosmetic Surgery (Rhinoplasty) by Comparison of 3D Images

Luigi M. Galantucci, PhD, Politecnico di Bari, Dipartimento di Ingegneria Meccanica e Gestionale, v.le Japigia 182, 70126 Bari, Bari 70126, ITALY; Leonardo Traversa, MD, Section of Legal Medicine, University of Bari, Bari , ITALY; Fulvio Lavecchia, PhD, Politecnico di Bari, Dipartimento di Ingegneria Meccanica e Gestionale, v.le Japigia 182, Bari 70126, ITALY; Antonio De Donno, PhD, P.zza Giulio Cesare n.11, Bari 70124, ITALY; Valeria Santoro, PhD, P.zza Giulio Cesare n.11, Bari 70124, ITALY; Eliana Di Gioia, DDS, Politecnico Bari, Bari, ITALY; Michele Roberto, MD, P.zza Giulio Cesare 11, Bari , ITALY; Sergio Lubelli, MS, Sezione di Medicina Legale, Piazza Giulio Cesare, 11, Bari 70124, ITALY; and Francesco Introna, MD, Sezione di Medicina Legale, Piazza Giulio Cesare, 11, Bari 70124, ITALY*

The goal of this presentation is to provide a tool based on scientific and innovative 3D reconstruction useful for an objective comparison between features of the faces in the pre- and post-operative period; in particular, the study focused on changes in the characteristics of the nose after surgery.

This presentation will impact the forensic science community by showing the usefulness of the reconstruction and analysis of 3D models pre- and post-surgery, allowing attendees to view, in an objective manner, changes of the nasal morphology.

This study first obtained the consent of the participants consisting of eight patients aged between 23 and 40 years old, who had chosen to undergo cosmetic surgery of the nose. Three acquisitions were made by the camera: on the pre-operative day, seven days, and 90 days after surgery. The stereo photogrammetric system used consists of two 3D cameras with a resolution of ten megapixels, a dual optical zoom of 3X and maximum picture resolution of 3888 x 2592. On the 3D images of the faces, landmarks were set to study the morphology of the nose (nasal, pronasal, subnasal, upper lip, left and right wing). Then the distances, indices, angles, volume, and the nasal area were calculated. This study focused on the pre- and post-operative values at 90 days; post-operative values detected a short time after surgery were not used because of the influence of inflammation of the soft tissues. Changes can be represented *qualitatively* by analyzing the color maps and *quantitatively* by numerical extrapolation of differences in measures, volume, and surface of the noses compared. Statistical analysis has also allowed assessment of how the measurements of the nose varied after a rhinoplastic surgery. This study showed that the width of the nose, the length of the nose bridge, and the height and the length of the nasal philtrum tend to vary little after rhinoplasty and thus can be taken into account for the possible recognition of a subject accused of a crime who undergoes cosmetic surgery of the nose. This comparison can be an effective tool in medical-legal cases: the professional responsibility of the plastic surgeon allows one to assess qualitatively and quantitatively the differences of the nose, frequently the subject of the claim. The comparison of 3D models pre- and post-surgery allows an objective view of the changes in nasal morphology. These data represent an important proof that the consultants can present in court on the basis that this comparison is made between 3D models perfectly aligned with each other and overlapping. The study also has an interesting application in the context of personal identification; in fact, the analysis of changes in the morphological characteristics of the face, determined by a rhinoplasty surgery, allows one to define the difference between a subject filmed before plastic surgery of the nose and a suspect that has deliberately decided to fake his or her appearance. The results of this study encourage an expansion of the search.

3D Images, Rhinoplasty, Surgery

B2 Forgery Detection From Printed Images: A Tool in Crime Scene Analysis

Luigi Saravo, PhD, Dalmonte Street, Rome 00123, ITALY; Irene Amerini, PhD, Viale Morgagni 65, Firenze 50134, ITALY; Roberto Caldelli, PhD; Alberto Del Bimbo, Viale Morgagni 65, Florence 50134, ITALY; Andrea Di Fuccia, Via Tor Di Quinto 121, Rome 00121, ITALY; and Annapaola Rizzo, MD, Via Battistini, Rome 00100, ITALY*

After attending this presentation, attendees will understand the risk of image manipulation and the tools for forgery detection.

This presentation will impact the forensic science community by focusing on the importance of forensic tools in image authenticity.

The preliminary analysis of the genuineness of a photo is the first step of any forensic examination that involves images, in cases where there is not a certainty of its intrinsic authenticity.

Digital cameras have largely replaced film-based devices. Until recently, in some countries, only images made from film negatives were considered fully reliable in court. There was widespread prejudicial thought regarding a digital image which, according to some people, could not ever be considered legal proof, because of its "inconsistent digital nature."

Great efforts have been made by the forensic science community in this field and now different approaches have been unveiled to discover and declare possible malicious frauds in order to establish whether an image is authentic or not or, at least, to assess a certain degree of probability of its "pureness."

In this day and age, it's an easy practice to manipulate digital images by using powerful photo-editing tools. In order to alter the original meaning of the image, copy-move forgery is the one of the most common ways of manipulating the contents. With this technique, a portion of the image is copied and pasted once or times elsewhere into the same image to hide something or change the real meaning of it.

Whenever a digital image (or a printed image) will be presented as evidence in a court, criteria should be followed to analyze the document with a forensic approach to determine if it contains traces of manipulation.

Image forensics literature offers several examples of detectors for such manipulation. Among them, the most recent and effective are those based on Zernike moments and those based on Scale Invariant Feature Transform (SIFT). In particular, the capability of SIFT to discover correspondences among similar visual contents allows the forensic analysis to detect even very accurate and realistic copy-move forgeries.

In some situations, however, instead of a digital document, only its analog version may be available. It is interesting to ask whether it is possible to identify tampering from a printed picture rather than its digital counterpart.

Scanned documents or recaptured printed documents by a digital camera are widely used in a number of different scenarios, from medical imaging and law enforcement to banking and daily consumer use.

In this presentation, the problem of identifying copy-move forgery from a printed picture is investigated. The copy-move manipulation is detected by proving the presence of copy-move patches in the scanned image by using the Copy-Move Forgery Detection (CMFD) method; previous methodology has been adapted in a version tailored for printed image case (e.g., choice of the minimum number of matched keypoints, size of the input image, etc.).

A real case of murder is presented where an image of a crime scene, submitted as printed documentary evidence, had been modified by the defense advisors to reject the theory of accusation given by the prosecutor.

The goal of this presentation is to experimentally investigate the requirement set under which reliable copy-move forgery detection is possible on printed images in such a way that the forgery test is the very first step of an appropriate operational checklist manual.

Forgery Detection, Copy-Move Tampering, Crime Scene Investigation

B3 A Comparison Between the Windows® 8 & Windows® 7 Registries

Matthew Brewer, 839 9th Avenue, Apt 1, Huntington, WV 25701; Chris Vance, BS, 1401 Forensic Science Drive, Huntington, WV 25701; Terry Fenger, PhD, 1401 Forensic Science Drive, Huntington, WV 25701; and Robert J. Boggs, 1401 Forensic Science Drive, Huntington, WV 25701*

WITHDRAWN

B4 Comparison of Super Resolution Image Enhancement Algorithms for Forensic Image Analysis

Kenji Kurosawa, 6-3-1 Kashiwanoha, Kashiwa, Chiba 277-0882, JAPAN; Ken'ichi Tsuchiya, PhD, 6-3-1 Kashiwanoha, Kashiwa, Chiba 2770882, JAPAN; Kenro Kuroki, PhD, 6-3-1 Kashiwanoha, Kashiwa, JAPAN; and Norimitsu Akiba, PhD, 6-3-1 Kashiwanoha, Kashiwa, JAPAN*

After attending this presentation, attendees will gain an understanding of some principles of multi-frame Super-Resolution (SR) image enhancement techniques; various SR algorithms have been proposed, quality of the resulting images are different depending on the algorithm, and the optimum algorithm depends on the type of processing images.

This presentation will impact the forensic science community by providing the experimental results showing the best SR algorithm varies depending on the nature of source images. Even if image quality is not improved with a specific SR algorithm, there is a possibility of obtaining a better resulting image by using a different algorithm. This knowledge will be useful for forensic image analysts who think that the multi-frame SR techniques are not functioning well for real-case images.

Videos or images that were recorded by surveillance or any other cameras can be objective evidence leading to criminal investigation. However, in many cases, the recorded images cannot be effectively utilized due to insufficient spatial resolution of the image. For such image degradation factor, multi-frame SR processing is highly effective for image quality improvement: it is possible to improve the spatial resolution of the image by integrating information from many images. Various algorithms have been proposed for multi-frame SR, and their effectiveness has been shown in the literature.[1,2] However, from the experiences of some professionals, it did not work well to most actual case videos even though clear results are shown in academic papers.

This study will present experimental results of the performance of various multi-frame SR algorithms using various image sequences including images taken by surveillance cameras. For the experiments, more than five registration algorithms (Keren, LK, Farneback, Brox, Dense LK, Simple Flow, etc.) and five reconstruction algorithms (Interpolation, POCS, NC, BTV, MAP) were implemented; usually multi-frame SR processing is performed in two steps (registration and reconstruction). These SR algorithms were written in C++ language and they were implemented using the computer vision library OpenCV 2.4. For the combination of these algorithms and input image sequences, the resulting image quality was assessed. The input image sequences included both computer-generated and camera-recorded image sequences.

The results show that some surveillance camera images can be improved with the SR image processing under a specific condition so as to identify unknown characters. However, in comparison with the images that were generated in a computer, image quality improvement was lower for the camera recorded images. Furthermore, it was found by the experiment that the optimum algorithm was different from the source images. The reason for this was assumed to be due to the difference of the image observation model that each algorithm hypothesized. Therefore, from the aspect of the actual image analyses on crime investigations, it is considered important to implement various SR algorithms and to select the optimum one according to the source video; because a wide variety of evidentiary materials are treated in the forensic activities.

References:

1. Milanfar P, editor. Super-Resolution Imaging. Boca Raton: CRC Press, 2011.
2. Chaudhuri S, editor. Super-Resolution Imaging. Dordrecht: Kluwer Academic Publishers, 2001.

Image Enhancement, Super Resolution, Algorithm

B5 Random Access Memory Persistence: When Does It Go Away?

Walter T. Hart, MBA, 149 Hamerton Avenue, San Francisco, CA 94131*

After attending this presentation, attendees will understand some basic principles and behaviors related to the persistence of computer random access memory.

This presentation will impact the forensic science community by providing a basic understanding of what forensics artifacts can be found in Random Access Memory (RAM) data captures and what affects its persistence when a computer is shut down, power is removed, or other events occur that can affect RAM.

RAM is known to potentially contain many forensic artifacts related to investigations such as incident response, child