F63 Superimposition 3D Skull/Picture of a Missing Person: A New Technique of Identification

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After attending this presentation, attendees will learn a new technique of 3D surface acquisition and superimposition 3D skull using photogrammetry.

This presentation will impact the forensic science community by a standardized technique for personal identification based on 3D superimposition.

Much contemporary debate in forensic science concerns the alternative methods to approach at personal identification on skeletal remains. Emerging 3D surface acquisition technologies have recently introduced new skull scanning methodologies. Among passive methods, photogrammetry has proved to be particularly promising in the evaluation of skull morphology. Photogrammetry currently provides the most cost-effective 3D capturing system, being fast, inexpensive, non-invasive; the equipment necessary for acquisition is easily transportable and offers high reliability. The technique, indeed, was demonstrated to be suitable for capturing facial morphology for clinical and anthropological usage. This method of experimental research was aimed at developing an alternative to DNA analysis when this is not available. This study applied the technique of superimposition 3D skull/face pictures to 13 cases of identification of skeletal remains from unknown subjects: five women and eight men. In two cases, crossed superimpositions were applied; in the first between two skulls of female skeletal remains and in the second case between five skulls found in a cemetery mass grave. This technique involved four steps:

Prepatory Phase: A picture of missing person was analyzed and improved. Pictures with better view of missing person face landmarks were then chosen.

3D Acquisition Phase: A 3D photogrammetric avatar of the skull was created; this phase only required 4 photos simultaneously taken with a calibrated camera.

Superimposition Phase: This phase was the preparatory for the final step. The 3D skull was then carefully spatially oriented in the same position as in the photos and snapshots were taken. During the morphological analysis the snapshot of the skull was superimposed on the picture of the missing person's face picture by a specific software.

Metric Image Analysis: 3D skull than was carefully spatially oriented in the same position as in the photos, and snapshots were taken. To perform this step it was necessary to clearly recognize at least five landmarks on the skull using a suitable software. A 3D parameterized avatar of the skulls was created with a photogrammetric technique and photos of the missing person were selected and acquired. In the metric image analysis step, a quantitative comparison between the image of the missing person face and the snapshot obtained was carried out. Objective landmarks, as exocanthions, glabella, and subspinal point were marked on the 3D skull and on the missing person face to calculate the distance of the absolute points detected on the two images.

Results: The absolute and relative distances between the marked points, the perimeters, and the areas of the triangles, obtained by connecting the points, and the compactness indices were automatically calculated with a suitable program.

Conclusion: The morphologic phase revealed a full overlap between skulls and photos of disappeared persons. Metric phase revealed that correlation coefficients of this values, higher than 0.998-0.997, allow confirmation of the identification hypothesis.

Photogrammetry, Personal Identification, 3D Superimposition

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