H14 Accuracy Testing of Computerized Facial Approximations by Comparison With Antemortem Photographs

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After attending this presentation, the audience will have an overall understanding of a cost effective, automated method of facial approximation, an opportunity to visually compare computer generated images with corre- sponding antemortem photographs, and an overview of a unique application of facial recognition software for the identification of unknown human remains.

This presentation will impact the forensic community by introducing and illustrating an automated, objective, inexpensive, and rapid method of completing facial approximations for use in the identification of skeletal and decomposing remains of victims of homicide, mass disasters, and war crimes.

Traditional methods of facial approximation of unknown human remains combine forensic anthropology biological profiles, tissue depth charts, and artistic talent. Three primary issues with traditional methods are time, expense, and subjectivity. Often described as a blending of art and science, these methods require a skilled artist and are labor intensive and therefore expensive. Traditional methods do not effectively address decom- posing remains or situations with a large number of remains, such as mass disasters and genocides.

This research tested the ability of humans to match computer generated facial approximation images with antemortem photographs. Facial approx- imations produced by a computer prototype were without head or facial hair, and had closed eyes and a smooth skin surface. Previous studies by other researchers have compared traditional facial approximations with ante- mortem photographs, or compared computer-generated images with other computer-generated images. However, this is the first known research to test whether human volunteers could match computer generated facial approximations of test subjects (without hair and with closed eyes) with actual antemortem photographs of those test subjects. A second test was conducted to determine if facial recognition software could be used to match computer generated facial approximations with antemortem photographs. A comparison of human versus computer accuracy rates will be presented.

Human Recognition of Computerized Facial Approximations: Ten human skulls of European ancestry (six females and four males) were selected for a photographic validation by face pool and resemblance rating validation tests. These ten test subjects were from the William M. Bass Donated and Forensic Skeletal Collections at the University of Tennessee at Knoxville. Facial approximations completed using a prototype software were visually compared with antemortem photographs by four participant groups (N = 103). Participants were asked to choose the face pool photo- graph that most closely resembled the facial approximation. In a second test, the same volunteers were asked to rate (on a scale of 1 to 5) how closely facial approximations of target subjects resembled an antemortem photo- graphs. Results of the face pool and resemblance rating testing will be presented.

Computer Recognition of Computerized Facial Approximations: Facial recognition software was used to test whether a computer would be more accurate in the matching of computerized facial approximations than human recognition. As a subset of a larger research project, the same ten human skulls used in the human recognition testing were entered into a facial recognition software program. Antemortem photographs of the ten test subjects were added to the photographic database of the system. Results of the facial recognition testing and a comparison of human versus computer recognition will be presented.

All facial approximations in this research were prepared using a cutting edge prototype, ReFace (*Reality Enhancement Facial Approximation by Computational Estimation*). This computerized facial approximation system is currently undergoing validation at the Counterterrorism and Forensic Science Research Unit (CFSRU) of the FBI Laboratory Division in Quantico, Virginia. The prototype extrapolates an “approximation” of a face from a computed tomography (CT) scan of an articulated skull using a database of CT scans of living individuals. Preliminary research on the prototype indicated that under optimal conditions, facial approximations of test subjects bore a striking resemblance to antemortem photographs (Moyers *et al* 2006). Additionally, the prototype has the ability to use CT data to extract a skull model from decomposing human remains without removing and defleshing the skull. As the process is fully automated, subjectivity has been eliminated. Time and expense are also minimized, as the system does not require artistic talent to produce a facial approximation.

An objective, rapid, and low cost method of facial approximation is urgently needed to address the current backlog of more than 40,000 uniden- tified sets of human remains in the United States (Ritter 2007), as well as high numbers of unidentified skeletal and decomposing remains from mass disasters and war crimes. In addition to the benefit of identification to victims and their families, such a system could provide assistance to national and international investigative and law enforcement agencies in the identification and prosecution of those responsible.

References:

1 Ritter, N. 2007. Missing Persons and Unidentified Remains: The nation’s Silent Mass Disaster. National Institute of Justice Journal 256:2-7.

2 Moyers, D. K. 2007. Validation Study of ReFace (Reality Enhanced

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Facial Approximation by Computational Estimation). Unpublished Thesis, University of Tennessee at Knoxville.

3 Moyers, D K, H L Peters, M R Mahfouz, M A Taister. Validation of Computerized Facial Approximation Using Re/Face. Presented at the 12th Scientific Meeting of the International Association for Craniofacial Identification Conference, November 1-4, 2006, Istanbul, Turkey.

Facial Approximation, Facial Recognition, Computer Prototypes

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