B11 Preliminary Assessment of Discrimination of Twins in Photographs Based on Facial Blemishes

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After attending this presentation, attendees will be aware of efforts to utilize facial blemishes as a potential means of identification in photographs.

This presentation will impact the forensic science community by exposing them to current research efforts to establish a statistical basis to support the Digital and Multimedia Sciences (DMS) discipline of forensic facial comparisons – a critical aspect of all forensic disciplines in light of the National Academy of Science report. Attendees should recognize a need to develop a deeper understanding of this and other emerging forensic disciplines within DMS and consider their applicability to their forensic laboratory.

Digital cameras capable of recording both still images and videos are ubiquitous in our society. Likewise, video surveillance through the use of closed-circuit television systems is becoming more prevalent. Frequently, law enforcement or intelligence agencies have a requirement to identify subjects depicted in those photographs and videos. The growing interest in both facial recognition and facial identification led the Federal Bureau of Investigations to create the Facial Identification Scientific Working Group (FISWG) in 2009. The mission of FISWG is to develop consensus standards, guidelines, and best practices for the discipline of image-based comparisons of human features, primarily face, as well as to provide recommendations for research and development activities necessary to advance the state of the science in this field.[1]

As background, FISWG defines facial recognition as "[t]he automated searching of a facial image in a biometric database (one-to- many), typically resulting in a group of facial images ranked by computer-evaluated similarity," while facial identification is defined as "[t]he manual examination of the differences and similarities between two facial images or a live subject and a facial image (one-to-one) for the purpose of determining if they represent the same person."[2] In a practical sense, (automated) facial recognition systems generate candidate lists which must then be evaluated by a human reviewer performing facial identification.

While there has been extensive research conducted in facial recognition and, to a lesser extent, facial identification within both academic and industrial settings, this research has not yet converged to a single consensus set of standards of practice comparable to fields such as DNA analysis or fingerprint analysis, nor has a statistical basis for identification or exclusion been established. As a result, fully automated face recognition has not yet achieved a level of reliability and

repeatability that make it suitable for use as a means of identification in the court room. Likewise, while the manual comparison process of facial identification has been accepted for expert testimony in multiple United States federal and state courts, it is lacking in a statistical basis from which conclusions may be drawn.

One attempt to address the statistical basis for human identification from facial images is the Magna Study.[3,4] In this large scale study involving over 3,000 subjects, it was determined that a meta-analysis of anthropometric measures of landmarks common to all human faces is not sufficient to discriminate between individuals. Put another way, this study found that the geometric distribution of a large set of landmarks common to all human faces (e.g., corners of the eyes and mouth) is not sufficiently unique to allow one to individualize a subject. Additional work remains to be performed on the Magna data to determine to what degree individuals might be segmented into individual classes based on the distribution of these landmarks. However, the Magna result indicates that facial features other than common landmarks will be necessary to support classification to groups smaller than 1% of the population. Facial blemishes, such as freckles or moles, are currently considered to be the best candidates for these features, as they are presumed to be comparable to friction ridge minutiae.

Incorporation of facial blemishes as features has already been shown to improve automated face recognition software.[5] The current effort to be described in this presentation would extend the utilization of such features for automatic face recognition, but will also have applicability to the forensic use of facial identification. More specifically, the current effort is intended to assess the ability to discriminate between identical and fraternal twins based solely on the distribution of facial blemishes. The hypothesis to be tested is that the distribution of blemishes on one twin's face will differ from the distribution of blemishes on the other's face. A secondary hypothesis to be tested is that the distribution of blemishes on any given face is random.

Data supporting this effort has already been collected for approximately 100 pairs of twins in 2009 at the Twins Days convention, held annually in August in the town of Twinsburg, Ohio. An additional collection is planned for 2010. For this analysis, each facial image will be processed using a face detection algorithm based on the work of Viola and Jones[6] that returns the bounds of a candidate face.

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An Active Shape Model, first developed by Cootes et al.,[7] is fit to the face's bounding region, yielding a set of face feature locations that correspond to anthropometrically or photometrically significant points. Combinations of these points define one or more face-centered coordinate systems, providing a normalized basis for feature location. After normalization, blemishes will be identified using an automated extraction technique based on an approach first developed by Park and Jain.[5] Once blemishes have been marked, their distribution will then be determined for each subject and comparisons performed between subjects – not just within twin pairs, but across the entire population of subjects.

References:

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