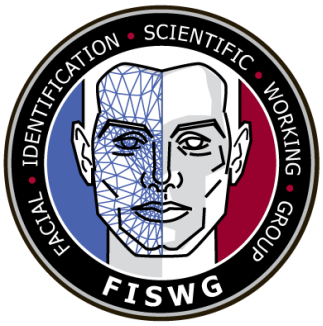

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Facial Comparison Overview and Methodology Guidelines

1. Scope

1.1 The purpose of this document is to provide guidelines and recommendations to the practitioner for conducting facial comparisons.

1.2 This standard does not purport to address all safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

2.1 *ASTM Standards:* [1]

E2916 Terminology for Digital and Multimedia Evidence Examination

E3149 Standard Guide for Facial Image Comparison Feature List for Morphological Analysis

E3115 Standard Guide for Capturing Facial Images for Use with Facial Recognition Systems

2.2 *Other Standard:* [2,3]

FISWG Recommendations for a Training Program in Facial Comparison

FISWG Guidelines and Recommendations for Facial Comparison Training to Competency

[1] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For Annual Book of ASTM Standards volume information, refer to the standard's Document Summary page on the ASTM website.
[2] Available from Facial Identification Scientific Working Group (FISWG), http://www.fiswg.org/documents.
[3] Available from Scientific Working Group on Digital Evidence (SWGDE), https://www.swgde.org/documents.

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SWGDE Technical Overview for Forensic Image Comparison

2.3 Other Referenced Documents:

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Vanezis, P., Lu, D., Cockburn, J., Gonzalez, A., McCombe, G., Trujillo, O., Vanezis M., Morphological classification of facial features in adult caucasian males based on an assessment of photographs of 50 subjects, Journal of Forensic Sciences, 41, 786-791, 1996.

3. Terminology

3.1 Definitions: See Terminology E2916 for digital and multimedia evidence examination terms.

4. Summary of Guide

4.1 This document reviews general types of facial comparisons, methods, and applications of facial comparison.

4.2 This document provides recommendations for general practices and methodologies to conduct facial comparisons.

5. Significance and Use

5.1 Facial comparison is a manual process conducted by a human which entails identifying similarities and dissimilarities between two (or more) images or an image and a live subject to determine whether they represent the same or different person.

5.1.1 Practitioners conduct facial comparisons to support different applications for the purpose of identity verification. The application, purpose, and resources available for a facial comparison task determine which category of facial comparison should be conducted.

5.1.2 Most applications fall primarily into one of the following four categories, however crossover may exist.

5.1.2.1 **Intelligence Gathering** for Identity Management comparisons is a component of the compilation of information relating to what is **believed** to be a single subject, even if the identity of the subject is not known.

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5.1.2.2 **Screening and Access Control** includes both image-to-image and image-to-person comparisons. Both occur in a high throughput environment and are thus limited in time (e.g., customs and immigration checkpoints).

5.1.2.3 **Investigative and Operational Leads** comparisons provide information, generally not intended for presentation in court, to assist operational personnel with meeting their objective (e.g., comparing an unknown subject featured in one or many images to images of known subjects to provide investigators with a potential name for a crime suspect).

5.1.2.4 **Forensic comparisons** provide information to assist a trier of fact (e.g., judge or jury).

5.2 There are three broad categories of facial comparison: assessment, review, and examination.

5.2.1 **Assessment** is a quick real time comparison of image-to-image or image-to-person typically carried out in screening and access control applications. Due to time constraints, an assessment is often undocumented and is considered the least rigorous of all the facial comparison categories.

5.2.2 **Review** is a comparison of image-to-image often used in either investigative and operational leads or intelligence gathering applications. A broad range of purposes and levels of rigor are involved in review, though it is by nature more rigorous than the assessment process and may require some level of documentation.

5.2.3 **Examination** is a comparison of image(s)-to-image(s) often used in a forensic application. Examination is the most rigorous category of facial comparison and typically requires more detailed documentation.

6. Comparison Methodology Guidelines

6.1 There are three comparison methods (morphological analysis, superimposition, and photo-anthropometry) currently recognized in facial comparison.

6.2 Depending on the application of the comparison, procedures may include some or all of the following steps: Analysis, Comparison, Evaluation, and Verification (referred to as ACE-V). Verification should be carried out in both facial review and facial examination.

6.3 **Morphological analysis** is the direct comparison of class and individual facial characteristics without explicit measurement. It is the method of facial comparison in which the features and components of the face are compared.

6.3.1 Morphological analysis (in some form) shall be the primary approach used for facial comparison in all categories: assessment, review, and examination. Observations in relation to similarity or dissimilarity are based on subjective assessment, evaluation, and interpretation.

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6.3.2 Morphological analysis is based on the evaluation of the correspondence among facial features, components, and respective component characteristics (presence, shape, appearance, symmetry, location, relative proportion, etc.). Features include those corresponding to the overall face, anatomical structures such as the nose or ear and their components (e.g., nose bridge, nostrils, ear lobes, helix), and discriminating characteristics, such as scars, marks and tattoos. The E3149 “Standard Guide for Facial Image Comparison Feature List for Morphological Analysis” provides a standard list of facial components and component characteristics to be assessed and evaluated during a morphological analysis. This methodology is used during the Analysis and Comparison steps in the ACE-V process.

6.3.3 The morphological analysis process should not rely on classification schemes (e.g., round face, Roman nose) which result in interobserver differences and are, therefore, not best practice (Iscan, 1993; Penry, 1971; Ritz-Timme et al., 2010; Vanezis et al., 1996).

6.3.4 Documentation of a morphological analysis is required. Documentation processes will depend on the agency guidelines and application of comparison undertaken. Screening and access control applications apply a more basic level of morphological analysis, therefore, documentation of the decision-making process is generally not required. Alternatively, when using morphological analysis for facial examination as in a forensic application, all steps of the ACE-V process should be fully documented.

6.3.5 Morphological analysis is highly dependent on the quality and quantity of the facial features and characteristics that can be compared. Image quality can be affected by factors including, but not limited to, image resolution, lighting, focus, pose, angle, orientation, and obstructions of facial features.

6.3.6 The morphological analysis method requires training consistent with the category of the comparison carried out.

6.4 **Superimposition** is the process of creating an overlay of two aligned images and comparing them visually.

6.4.1 Superimposition shall never be used as a stand-alone approach for facial image comparison and used *only* in conjunction with morphological analysis.

6.4.2 Superimposition can be applied only when two images are taken from the same viewpoint (images may be photographs, frames or images from video, or images synthesized from 3D face or head models). Images are aligned (e.g., scaled, rotated) with each other. There should be a concordance between images in all aspects of angle and perspective to avoid distortion of the spatial distribution of facial features and characteristics. Practitioners should use tools which preserve shapes and shall not use image processing techniques which may skew the images, facial proportions, or shapes.

6.4.3 Since superimposition is sensitive to image quality, both images should be captured under optimal conditions (as defined by E3115) or the use of this method may be misleading. Loss of image quality through blurring, compression artifacts, reduction

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in spatial resolution (e.g., number of pixels between the pupils), lens distortion, perspective distortion, etc. reduces the ability to determine the specific location of individual features, which subsequently reduces the ability to generate an accurate overlay/superimposition.

6.4.4 In cases where there are multiple copies of the same original image (e.g., forged identity documents), superimposition may be carried out on images displaying less than optimal quality.

6.5 **Photo-anthropometry** is the measurement of dimensions and angles of anthropometric landmarks and other facial features visible in an image in order to quantify characteristics and proportions. The measurements taken from one image are compared to the measurements taken from a separate facial image.

6.5.1 Photo-anthropometry shall not be used as an independent comparison method or in conjunction with another method for facial comparison in any categories: assessment, review, or examination. (Evison et al., 2010; Kleinberg, 2007; Moreton and Morley, 2011)

6.6 Apart from the methods described above, **holistic process** (i.e., the innate human ability to compare faces) will take place. It should be stressed that a holistic process is not a method. Human ability for holistic face comparison is highly variable and is dependent on a multitude of factors including, but not limited to, personal ability and familiarity with the subject. Studies have shown that human ability to compare unfamiliar faces is highly prone to error whereas comparison of familiar faces may be carried out accurately even when image conditions are poor. (Biederman & Kalocsai, 1997; Maurer, Le Grand, &Mondloch, 2002; Rossion, 2008).

7. Summary of Recommendations

7.1 The morphological analysis method is considered to be the best practice by the Facial Identification community for facial comparison. In the ACE-V process, morphological analysis is utilized during the analysis and comparison steps. Opinions are based on the results of the morphological comparison. When conducting morphological analysis for facial comparison, and the application warrants, all steps of the ACE-V process should be documented.

7.2 Superimposition shall only be used in conjunction with morphological analysis. Photo-anthropometry shall not be used for facial image comparison.