A70 A Simple Method for Estimating Subject-to-Camera Distance for Legitimate Craniofacial Superimpositions

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After attending this presentation, attendees will be introduced to a simple method for estimating face-to-camera distance from frontal facial photographs using face anatomy alone (palpebral fissure length) when focal length of the lens is known. This presentation will also compare accuracy of these results to those acquired using camera-to-subject distances extracted from the metadata of the corresponding digital image files (another technique that so far has gone uncommented upon in the superimposition literature). Normally, the inclusion of an inanimate object, or smiling expression with a view of teeth, in a facial photograph is thought to be required for matching skull-to-camera distance to face-to-camera distance in craniofacial superimposition. This is not true.

This presentation will impact the forensic science community by providing new simple methods for matching skull-to-camera to face-to-camera distances, as required for perspective distortion matching, when undertaking one-to-one anatomical comparisons in craniofacial superimposition.

Like any forensic science technique, video superimposition should be a scientifically robust procedure, subject to strict performance criteria. One of these criteria must be that the perspective distortions between the two images that are superimposed are the same, so that one-to-one anatomical comparisons can be undertaken. This requires knowledge about what subject-to-camera distance was used to acquire the facial photograph under analysis, but presently this is said to be impossible unless the photographer who took the photograph can be contacted (e.g., Sekharan says, "it is almost an impossible task to determine (subject-to-camera) distance exactly from the photograph").[1]

This study took frontal photographs of four subjects in the "lip shut" posture (one adult male, one adult female, one sub-adult female, and one juvenile male) with a known objective lens length (100mm) at distances between 1m and 10m serially increasing by 1m and used a relatively invariant facial trait (palpebral fissure length) to calculate face-to-camera distance with the formula: $d=f(1+a/b)$, where d=face-to-camera distance (m), f=focal length (mm), a=real-life object size (mm), and b=object size on the image receptor.

Using this method across all ten measurement scenarios for each subject, results indicate a mean percentage error of 7% (range=3.5%-10%) for face-to-camera distance estimation, which falls well within the tolerance levels to obtain <1% difference in facial dimensions at life size due to perspective distortion differences between photography sessions. Palpebral fissure measurement is, thereby, verified as a suitable method for gauging face-to-camera distances. Compared to subject-to-camera distance information extraction from the photographic file's metadata, the palpebralfissure measurement performed superiorly with only 8% absolute error compared to 23% error for the metadata.[2] This unambiguously verifies the palpebral fissure measurement as useful for craniofacial superimposition and as a cross-check of recalled photographic parameters by photographers reporting to have taken the original facial photograph.

Reference(s):

1. Sekharan P.C. 1973. A scientific method for positioning of the skull for photography in superimposition studies. *Journal of Police Science and Administration* 1(2):232-240.
2. Harvey P. *ExifTool* (Internet) 2015 www.sno.phy.queensu.ca/~phil/exiftool/

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