A. Purpose:

The Multimedia and Image Enhancement Unit may assist law enforcement agencies in enhancing and capturing video/audio evidence for investigative or evidentiary purposes from video/audio systems and also provide image comparison with known exemplars provided by the submitting agency or evidentiary items submitted to the Laboratory. Image comparison is an assessment of the correspondence between features in images and known objects or images retrieved from video and compared to known objects/reference images for the purpose of rendering an expert opinion regarding identification or elimination. The Unit may also produce a demonstrative exhibit of such comparisons. In some cases, an opinion/report may consist of a composite image showing demonstrative areas of consistent features.

B. Responsibility:

Forensic Science Examiners assigned to the Multimedia and Image Enhancement Unit or performing casework in the Unit.

C. Methodology:

There are a number of critical practices, processes, and factors used to ensure and demonstrate validity in forensic image comparison. The relative importance of any one of these may vary among cases. Regardless of the protocol used in conducting photographic comparisons, the methodology used should be documented:

Class vs. Individual Characteristics

The concept of class vs. individual characteristics is fundamental to forensic image comparison. Class characteristics are used to subdivide things into groups or classes. Individual characteristics allow one to differentiate objects within a class from one another. Individual characteristics may be used to uniquely characterize an object. They arise from such events as random natural or commercial processes, intentional alteration, and wear-and-tear. In the case of vehicle image comparison, the basic body type/style might be used to be included in a class characteristic or eliminated.

The ability to identify an individual person or object requires a correspondence of individual characteristics. The number of such characteristics necessary for such an identification is a function of the subject matter, the quality and quantity of details in the images, and the expertise of the analyst; no arbitrary number of characteristics is required. A correspondence of class characteristics may be useful for establishing candidate subjects. Likewise, a lack of corresponding class and/or individual characteristics can be used to eliminate potential subjects. In the case of a vehicle image comparison,

this might be the comparison of damage or missing parts to the vehicle. In the case of comparisons of a person, this might include the comparison of tattoos or scars or other biometric features.

ACE-V

A commonly accepted protocol applied to image comparisons is ACE-V (Analysis, Comparison, Evaluation – Verification). Not all image comparisons invoke this method. The Analysis stage involves a thorough assessment of the properties and attributes of the features contained in the images under examination.

In the Comparison stage, an assessment is made of the correspondence/discordance of the characteristics identified in the Analysis stage.

In the Evaluation stage, a tentative conclusion is reached and the correspondences/discordances are tested against it. All discordances are evaluated to determine if they reflect true differences between the subjects.

Three types of discordance may be observed:
(1) *Explainable differences*. Discordances may result from the imaging process (compression artifacts, watermarks, lens aberration) or conditions from the scene or object.
(2) *Unexplainable differences.* Discordances exist, but are of unknown source and significance.
(3) *Exclusionary differences.* Discordances that reflect a true difference between the objects under comparison. Such a difference establishes an elimination.

D. Procedure:

1. Prior to beginning the image comparison, the image selected for use in the comparison should be analyzed for the presence of artifacts. In order to accurately interpret the content of an image under examination, it is imperative that the examiner not mistake artifacts of the imaging process as reflective of physical properties of the subject depicted. The image should be analyzed to determine if resolution, compression, optical defects, sensor defects, lighting conditions, atmospheric conditions, and motion, among others, may introduce artifacts or other objects that may prevent correct interpretation. The images for comparison should be the same scale for accurate interpretation.

   If it is necessary to return to the original scene/recording device, measures should be taken to ensure that there have been no upgrades in software, maintenance of hardware that may have affected the position of the equipment or replacement of equipment. If one of these situations is noted, it should be noted that conditions are not optimal for image comparison purposes.

2. Image comparisons commonly involve an examination and evaluation of features observed in a submitted image or exported from a video to be compared to features of a known subject/object. This process may require image/video processing to enhance features for comparison. These processes should be carried out as referenced in SOP-MMIE-06 and SOP-MMIE-17.
3. Often it is necessary to determine that issues of image creation, lighting, and composition do not create artifacts that may affect the comparison. Reconstruction of the circumstances of the questioned image acquisition may be necessary especially if the image/video was captured/recorded using a camera with an infrared filter or the camera that captured the image was positioned in an angle that may affect the size and quality of the objects being compared. This reconstruction may consist of photographing or recording the object under comparable conditions (same digital/analog recording system) as the original submission was presented. If this avenue for reconstruction is no longer possible, then the examiner will note this in the report that this factor may affect the final image comparison results.
4. The examiner will import the selected images into Adobe Photoshop to provide the background canvas (composite) for the images to be compared. It is the examiners discretion on how he/she will demonstrate the corresponding objects/items being compared. Some acceptable visual markers may include numbers/letters, arrows, overlays and side by side visual comparisons.

   In cases in which an image is being compared to an image of a vehicle's make/model which was researched from common source vehicle manufacturer website; if this is being used as a comparative image, the website will be clearly marked with the address of the image. Additionally, the report will clearly note that this image was produced from a website and that the investigator must follow-up on the validity of the image posted.
5. After the examiner has determined which features/objects will be compared, the examiner will use one of the previously listed methodologies to evaluate these items. After evaluation, the examiner can render an opinion based on the findings as depicted below:

IMAGE COMPARISON LEVEL OF FINDINGS CONTINUUM	
Individualizing Characteristics Present	**Individualization**
Similar Characteristics	**Identification**

– cannot individualized to that object only	
Similarities Noted – No Conclusion *– cannot distinguish if artifacts are present*	
No Conclusion *– markings noted, but not enough detail to determine if similar*	
Dissimilarities Noted – No Conclusion *– cannot distinguish if artifacts are present*	
Dissimilar	
Elimination	**Elimination**
No Comparison Possible *– quality of image not suitable for image comparison*	**No Examination Conducted**

6. If the examiner notes any findings that may affect the image comparison, these findings will be listed in the report for the submitting agency.

E. References:

Adobe Corporation. (2005). *Adobe Photoshop CS2 User Guide.* San Jose: Adobe Systems Incorporated.

Adobe Corporation. Adobe Production Suite CS5 on-line help. www.adobe.com

Ang, T. (1999). *The Art of Digital Photography.* New York: Octopus Publishing Group.

Corel Corporation. (2008). *Corel Draw Graphics Suite X4 User Guide.* Ottawa: Corel Corporation.

Galer, M. & Horvat, L. (2001). *Digital Imaging.* Oxford: Butterworth-Heinemann.

Johnson. S. (2006). *On Digital Photography.* Cambridge: O'Reilly Media Inc.

SWGIT Guidelines. (2013). Special Working Group of Imaging Technology.

SWGIT – Section 16 Best Practices for Forensic Photographic Comparison (Version 1.1 2013.01.11)

State of Connecticut v. Alfred Swinton, SC 16548 (Connecticut 2004).