Scientific Working Group on Digital Evidence

Legal and Scientific Support Related to the Admissibility of Image Examinations

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1. Purpose

The purpose of this document is to provide information to image examiners when preparing for court for the admissibility of image evidence.

2. Scope

With the accessibility of information related to forensic analysis, admissibility challenges to opinion-based testimony are becoming more commonplace. Forensic examiners may find themselves being challenged as to their qualifications to give opinion testimony, to the specific analysis performed, to the reasoning behind their opinion, to the inability to create a statistical model for analysis, and ultimately, to any legal standard related to the analysis. This document will address these issues and provide information that may assist in responding to the most frequently encountered admissibility challenges in a courtroom.

3. Limitations

This document will not describe discipline specific analytical techniques or their limitations. Rather, this document is intended to assist practitioners and legal personnel in addressing admissibility issues related to image analysis. For further information on specific analytical techniques, see associated SWGDE best practices documents.

Examiners performing image analysis should have sufficient training and experience in image science to allow the formation of conclusions in the field in which an opinion is being rendered. However, this document is not intended to be a training manual, nor does it give specific guidelines as to topics for image examiner training. For further information on training guidelines, including training topics, see *SWGDE Training Guidelines for Image Analysis, Video Analysis, and Photography*.

This document will not address every challenge to image evidence that may arise and does not contain information related to specific products. Image analysis and the associated legal processes are constantly changing and updating, as such additional resources should be consulted to ensure up-to-date information is considered. This document should not be construed as legal advice.

In considering the constraints associated with the use of statistical methods and models, or in the absence of an appropriate model, in image examinations, the limitations should be acknowledged when stating opinions as a part of the legal process. This document will not provide methods or techniques to ascertain statistical certainty of the results. For further information on statistical models for forensic processes, see The American Statistical Association (ASA) “Position on Statistical Statements for Forensic Evidence.”

4. Legal Standards of Expert Testimony

In the United States, courts use two standards for the admissibility of expert testimony, both of which are grounded in legal precedent. First there is the *Frye Standard*, which is still in place in some jurisdictions, but has been largely replaced by the *Daubert Standard*. In addition, Daubert has been extended to cover technical experts through what is known as the *Kumho Tire Extension*. As to the admissibility of expert testimony, each court is empowered with discretion to allow any testimony under *Federal Rule of Evidence 702*. Challenges to this admission can be the basis for appeal under review of an abuse of this discretion. The basis for this review was established in *General Electric Co. v. Joiner,* 522 U.S. 136 (1997).

4.1 Federal Rule of Evidence 702 and Abuse of Discretion

In terms of admissibility, for such testimony to be allowed in consideration of a Court as a matter of fact, Federal Rule of Evidence 702 applies. This rule prescribes that expert testimony satisfy the following, in the estimation of the Court:

(1) the proffered witness must be an expert, as qualified by specialized knowledge, skill, training, experience or education;
(2) the expert must testify to scientific, technical or specialized knowledge; and
(3) the expert's testimony must assist the trier of fact.

The overriding consideration with regard to these three factors is that expert testimony should be admitted if it will assist the trier of fact. In *General Electric Co. v. Joiner,* 522 U.S. 136 (1997), the Supreme Court clarified Daubert, holding that an appellate court may still review a trial court's decision to admit or exclude expert testimony. The standard of review for this inquiry is the "abuse of discretion" standard.

For further information as to expert witnesses, see *SWGDE Introduction to Testimony in Digital and Multimedia Forensics*.

4.2 The Frye Standard

The Frye Standard was derived from *Frye vs. the United States,* 293 F. 1013 (D.C. Cir. 1923), a landmark case from 1923 in which the court held that for scientific evidence to be admitted, the scientific method must have reached general acceptance within the relevant scientific community. The Frye standard (or some variation thereof) is still in place in several states, although in most (as well as in Federal court), the standard has been replaced by the Daubert Standard.

4.3 The Daubert Standard

The Daubert Standard came from *Daubert vs. Merrill Dow Pharmaceuticals,* 509 U.S. 579 (1993). The standard lays out multiple criteria for the admittance of scientific testimony. Those criteria are:

- Whether the theory or technique employed is generally accepted in the relevant scientific community.

- Whether the theory or technique has been subjected to peer review and publication
- Whether the theory or technique has (or can) be tested
- Whether the theory or technique has a known error rate (and whether that rate is acceptable)
- Whether the theory or technique has standards controlling its operation.

Note that consideration is also given to whether or not the theory or technique was developed independent of litigation, though courts have regularly shown this is not a limiting factor to expert testimony.

4.4 The Kumho Tire Extension

The Kumho Tire Extension came from *Kumho Tire, Co. v. Carmichael,* 526 U.S. 137 (1999). In this case, attorneys for Carmichael called upon a tire failure analyst named Donald Carlson Jr. to determine if a fatal accident was caused by treatment of the tire beyond manufacturer specifications, or a manufacturing defect in said tire. The defense challenged this expert's testimony under the existing Daubert standard, as it could not meet those four criteria. Initially the court agreed, but upon reconsideration the court found that Daubert should be applied flexibly and that other factors could argue in favor of admissibility. In time, the court held that the Daubert factors did not apply to Carlson's testimony, which it characterized as skill- or experience-based. It is this extension that forms the basis of the admissibility of expert testimony which does not fall directly under a specific academic degree, accreditation, or certification.

4.5 Establishing Legal Basis for Expert Status

Considering the legal precedence discussed above, the following provides a legal basis for expert testimony.

4.5.1 Certification

Certification involves some type of test to demonstrate competence at a given task, such as the tasks listed above for image analysts. Certification can be completed by an examiner's agency or through external agencies and can be completed in a broad area (such as video/image analysis) or in a specific area (such as a piece of software).

4.5.2 Accreditation

Accreditation is the procedure by which an authoritative body gives formal recognition that a laboratory is competent to carry out specific tasks. Accreditation involves a laboratory demonstrating a complete quality assurance program for all examinations performed, including a training program for the certification of examiners, and a procedure for the assurance of mastery of concepts. Accredited labs also require examiners to complete regular proficiency exams, again to demonstrate knowledge and ability in the tested examination process. For more information on accreditation, see SWGDE document *Myths and Facts About Accreditation for Digital and Multimedia Evidence Labs*.

4.5.3 Publication

Support for the analysis can be garnered through research and contribution to peer-reviewed publications. Such publications assist with meeting the Daubert criteria, specifically the requirement to subject the techniques to peer review. It should be noted, while the Daubert standard applies specifically to theories and techniques, while the Kumho Tire extension applies to the expert. Consequently, even if the publication does not apply directly to the theory or technique to which the expert attests, it does speak to their personal skill or experience in the field, and thus can assist with satisfying the Kumho Tire extension as well.

4.5.4 Attestation

Part one of the Daubert standard refers to a theory or technique being accepted by the scientific community. One way to demonstrate acceptance of a theory or technique is through publications. Additionally, part five refers to a theory or technique being researched separate from litigation. An examiner should be aware of relevant research and publications. If an assumed expert were to testify, their status as an expert could be confirmed if they have been recognized by that community, such as by receiving an award, grant, or other recognition. Likewise, if an assumed expert is known to be in the process of conducting research on a topic prior to litigation, it could contribute to the court's decision on the expert's status.

4.5.5 Training and Experience

An examiner's training and experience should be considered when determining if they should be qualified as an expert. Training and experience should be documented and accurately reflect the knowledge, skills, and abilities of the examiner. For more information on training guidelines for image analysts, see the SWGDE document *Training Guidelines for Video Analysis, Image Analysis, and Photography*. In addition to training, an examiner's experience can assist in demonstrating their qualifications to be considered as an expert witness. In several cases, an expert was accepted based on their experience. One such case example is *Guidry v. Beauregard Electric Cooperative, Inc.* (2015), where the examiner was admitted as an expert due to having over forty years of experience in the field.

5. Admissibility Factors Specific to Forensic Image Analysis

The component parts of forensic image analysis are derived from numerous sources to ensure the process is both scientifically and legally valid. These sources include the practical observations of forensic practitioners, legal opinions issued by the courts, and from academic studies. It can be difficult for examiners presenting findings to have a complete understanding of both the legal and scientific basis for those findings.

Observation is the foundation upon which all image analysis methods are built. Even the most advanced of computer aided analysis should not be done without some observation. Such observation is the basis for hypothesis and experimentation, in the process of examinations and the formation of opinions. The process of methodical observational analysis is and always will be a critical part of image evidence analysis.

An overview of the legal and scientific foundations of forensic image analysis are presented below:

5.1 Image Content Analysis

Image Content Analysis involves the drawing of conclusions about an image based upon the image itself. Targets for content analysis include but are not limited to: the subjects/objects within an image, physical aspects of the scene (e.g., lighting or composition), and/or the process by which the scene was captured. For further information on content analysis, see the SWGDE document *Best Practices for Image Content Analysis*.

5.1.1 Academic Support for Image Content Analysis.

5.1.1.1 Bramble, S., Compton, D., Klasen, L. Forensic Image Analysis. 13th INTERPOL Forensic Science Symposium. 2001.

5.1.1.2 Kara, I., Korkmaz, C., Karatar, A., Aydos, M. A Forensic Method for Investigating Manipulated Video Recordings. Computer Fraud and Security, February 10, 2023.

5.1.1.3 Milliet, Q., Delemont, O., Margot, P. A Forensic Science Perspective on the Role of Images in Crime Investigation and Reconstruction. Science and Justice, Vol 54, Issue 6, December 2014. pp 470-480.

5.1.2 Legal Support for Image Content Analysis

The legal system has relied upon image content analysis since shortly after the invention of photography, and prior to that with the generation of likenesses for identification purposes. Therefore, there are far too many examples to specifically list in this section. For examples of precedence that relies upon image content analysis, see cases listed elsewhere in this document, or any other that utilizes facial comparison or identification using images.

5.2 Photographic Comparison

Photographic comparison is the process of comparing images of questioned objects or persons to known objects or persons or images thereof, and making an assessment of the correspondence between features in these images for rendering an opinion regarding identification or elimination. For further information on photographic comparison, see the SWGDE documents *Best Practices for Photographic Comparison for All Disciplines* and *Technical Overview for Forensic Image Comparison*.

5.2.1 Academic Support for Photographic Comparison

5.2.1.1 Adams, Norman, et al. "Upper-Bounding the Incidence Rate of Associations Between Camouflage Uniforms and Surveillance Images*." Journal of forensic sciences 54.6 (2009): 1393-1406.

5.2.1.2 Cameriere, Roberto, Danilo DeAngelis, and Luigi Ferrante. "Ear identification: a pilot study." Journal of forensic sciences 56.4 (2011): 1010-1014.

5.2.1.3 Hauser, Kitty. "A Garment in the Dock; or, How the FBI Illuminated the Prehistory of A Pair of Denim Jeans (Winner of the Journal of Material Culture Alfred Gell essay competition 2004)." Journal of Material Culture 9.3 (2004): 293-313.

5.2.1.4 Hoogstrate, A. J., Hazem Van den Heuvel, and E. Huyben. "Ear identification based on surveillance camera images." Science & Justice 41.3 (2001): 167-172.

5.2.1.5 Kumar, Ajay, et al. "Personal authentication using hand images." Pattern Recognition Letters 27.13 (2006): 1478-1486.

5.2.1.6 Macdonald-McMillan, Briony. "The quantification of dorsal hand features of interest to assist forensic human identification." MSc (Res) Dissertation, University of Dundee (2011).

5.2.1.7 Mallett X. “Hand Comparison: The Potential for Accurate Identification/Recognition in Cases of Serious Sexual Assault.” Proceedings of the American Academy of Forensic Sciences. 2010.

5.2.1.8 Malone, CA, Hein, M, and Salyards, M. (2015), Inter-/Intra- Observer Reliability of Hand Assessment Using Skin Detail: A Count-Based Method. Journal of Forensic Sciences, 60: 1605-1612.

5.2.1.9 Malone, CA. (2015), Photographic Analyses Using Skin Detail of the Hand: A Methodology and Evaluation. Journal of Forensic Sciences, 60: 326-300.

5.2.1.10 Porter, Glenn, and Greg Doran. "An anatomical and photographic technique for forensic facial identification." Forensic science international 114.2 (2000): 97-105.

5.2.1.11 Slot, Ana, and Zeno JMH Geradts. "The Possibilities and Limitations of Forensic Hand Comparison." Journal of forensic sciences 59.6 (2014): 1559-1567.

5.2.1.12 Spaun, Nicole A. "Forensic biometrics from images and video at the Federal Bureau of Investigation." Biometrics: Theory, Applications, and Systems, 2007. BTAS 2007. First IEEE International Conference on. IEEE, 2007.

5.2.1.13 Spaun N; Vorder Bruegge R. 2008. Forensic Identification of People from Images and Video. 2nd IEEE Conference on Biometrics: Theory, Applications and Systems.

5.2.1.14 Srinivas, Nisha, et al. "Analysis of facial marks to distinguish between identical twins." Information Forensics and Security, IEEE Transactions on 7.5 (2012): 1536-1550.

5.2.1.15 Vorder Bruegge, Richard W. "Photographic identification of denim trousers from bank surveillance film." Journal of forensic sciences 44 (1999): 613-622.

5.2.1.16 Johnson, D. B., et al. "Establishing likelihood ratios for patterned garment comparisons from seam measurement data." Journal of forensic sciences 58.3 (2013): 631-644.

5.2.2 Legal Support for Photographic Comparison

5.2.2.1 *United States v. Legs*, 28 F.4th 931 (8th Cir. 2022)(any alleged error in admitting expert testimony regarding photographic comparison of hands in a

CSAM case was harmless, photographs could be compared by trial jurors who could discern similarities and find guilt beyond a reasonable doubt).

5.2.2.2 *United States v. McKreith*, 140 Fed.Appx. 112 (11th Cir. 2005)(trial court properly admitted expert testimony involving photographic comparison of hands and shirt (Successful Daubert hearing).

5.2.2.3 *United States v. Alexander*, 816 F.2d 164 (5th Cir. 1987)(testimony of photographic comparison expert, who was former noFBI agent admissible in case where only substantial evidence connecting defendant to robbery was bank employee's identification of defendant's driver's license photograph).

5.2.2.4 *United States v. Oaxaca, et, al.*, 569 F.2d 518 (9th Cir. 1978)(comparison photographs of clothing properly admitted in armed robbery trial).

5.2.2.5 *United States v Hayes* 553 F.2d 824 (2d Cir. 1977)("photographic comparison may be sufficient to establish guilt beyond a reasonable doubt…and thus…may constitute probable cause for an arrest" in a serial robbery case).

5.2.2.6 *United States v. Brown*, et. al., 501 F.2d 146 (9th Cir. 1974)(Testimony of expert in photographic identification identifying clothing and pistol seized from apartment as items depicted in photographs taken by bank surveillance camera at time of robbery was admissible in bank robbery prosecution).

5.2.2.7 *Commonwealth v. Fitzpatrick*, 463 Mass. 581, 977 N.E.2d 505 (Mass. 2012)(photographic comparison of a pickup truck).

5.3 Photogrammetry

Photogrammetry is the process of obtaining dimensional information regarding objects and people depicted in an image. Photogrammetry used forensically usually involves examinations to determine the height of a subject within an image, the length of an object within an image, or the speed of an object depicted within video. For further information, see SWGDE document *Best Practices for the Forensic Use of Photogrammetry*.

5.3.1 Academic Support for Photogrammetric Examinations

5.3.1.1 Miller, S. A Comparison of Four Photogrammetry Methodologies in Determining Unknown Height of Persons. University of Colorado at Denver. ProQuest Dissertations Publishing, 2020. 27957879.

5.3.1.2 Epstein, B.; Westlake, B.. Determination of Vehicle Speed from Recorded Video Using Reverse Projection Photogrammetry and File Metadata. J Forensic Sci, September 2019, Vol. 64, No. 5 doi: 10.1111/1556-4029.1 4053

5.3.1.3 Sneddon, J.. Performing Reverse Projection Photogrammetry of Surveillance Video with HVE. HVE-WP-2019-3.

5.3.1.4 Meline, K.; Bruehs, W. A Comparison of Reverse Projection and Laser Scanning Photogrammetry. Journal of Forensic Identification; Alameda Vol. 68, Iss. 2, (Apr-Jun 2018): 281-292.

5.3.1.5 Smith, G.; Allsop D. A Case Comparison of Single-Image Photogrammetry Methods. SAE Transactions Vol. 98, Section 6: JOURNAL OF PASSENGER CARS (1989), pp. 862-869

5.3.1.6 Bruehs, W.; Stout, D., "Determination of average vehicle speed utilizing reverse projection," Journal of Forensic Science. 2022;67:188–199. https://doi.org/10.1111/1556-4029.14891

5.3.2 Legal Support for Photogrammetric Examinations

5.3.2.1 *United States v. Kyler*, 429 Fed.Appx. 828 (11th Cir. 2011)(following Daubert hearing, height analysis through reverse projection photogrammetry was determined to be sufficiently reliable to be admitted at trial).

5.3.2.2 *United States v. Williams*, 235 F. Appx 925 (3d Cir. 2007)(following Daubert hearing, reverse projection photogrammetry technical was sufficiently reliable to determine height of suspect captured on surveillance camera in bank robbery case to be admitted at trial).

5.3.2.3 *United States v. Holmes*, 30 Fed.Appx. 302 (4th Cir. 2002)(photogrammetric analysis properly established height of robbery suspects).

5.3.2.4 *United States v. Johnson*, 114 F. 3d 808 (8th Cir. 1997)(photogrammetry expert properly testified as to height of suspects in robbery video)

5.3.2.5 *United States v. Quinn*, 18 F.3d 1461 (9th Cir. 1994)(expert's testimony regarding use of "photogrammetry" to render opinion as to height of individual in bank surveillance photograph was properly admitted at trial).

5.3.2.6 *Chapman v. Bernard's, Inc.*, 167 F Supp. 2d 406 (D.Mass 2001)(testimony of photogrammetric expert properly admitted in negligence action).

5.3.2.7 *Maryland v. Matthews*, 479 Md. 278, 277 A.3d 991 (Ct.App. 2022)(trial court properly admitted photogrammetric analysis despite expert's inability to calculate effect off all potential variables on degree of uncertainty).

5.3.2.8 *Guidry v. Beauregard Electric Cooperative, Inc.*, 164 So. 3d 266 (La.Ct.App. 2015)(trial court did not abuse its discretion by accepting engineer who testified on truck driver's behalf as expert in photogrammetry in driver's action against electric company to recover damages for injuries allegedly sustained when his truck came into contact with an electric line owned and maintained by company; engineer had 46 years of experience in his field, expert employed photogrammetry in his profession throughout his career, and expert had previously testified in court to findings made using photogrammetry)

5.4 Image Authentication

Image Authentication is defined as the application of image science and domain expertise to discern if a questioned image is an accurate representation of the original data by some defined criteria, and/or the determination of the original source of the image. In layman's terms, image authentication is used to determine whether the content captured in imagery is real or

manipulated, as well as determining the device used to capture the imagery. For further information on image authentication, see the SWGDE document *SWGDE Best Practices for Image Authentication*.

5.4.1 Academic Support for Image Authentication

5.4.1.1 Zeno J Geradts, Jurrien Bijhold, Martijn Kieft, Kenji Kurosawa, Kenro Kuroki, Naoki Saitoh. Methods for identification of images acquired with Digital cameras

5.4.1.2 W. Sabrina Lin, Steven K. Tjoa, H. Vicky Zhao, K. J. Ray Liu. Digital Image Source Coder Forensics Via Intrinsic Fingerprints. IEEE Transactions on Information Forensics and Security, VOL. 4, NO. 3, SEPTEMBER 2009

5.4.1.3 Mo Chen, Jessica Fridrich, , Miroslav Goljan, Jan Lukáš. Source Digital Camcorder Identification Using Sensor Photo Response Non-Uniformity

5.4.1.4 Ashwin Swaminathan, Min Wu, and K. J. Ray Liu. Nonintrusive Component Forensics of Visual Sensors Using Output Images. IEEE Transactions on Information Forensics and Security, VOL. 2, NO. 1, MARCH 2007

5.4.1.5 Faird, Hany, Digital image ballistics from JPEG quantization. Technical Report 2006-583. Dartmouth College, Computer Science. 2006.

5.4.1.6 Farid, Hany, Digital image ballistics from JPEG quantization: A follow-up study. Technical Report 2008-638. Dartmouth College, Computer Science. 2008.

5.4.1.7 Kornblum, Jesse D., Using JPEG quantization tables to identify imagery processed by software. Digital Investigation 5 (2008) S21-S25. Elsevier. http://old.dfrws.org/2008/proceedings/p21-kornblum.pdf

5.4.1.8 Tuladhar, Punnya, "Nonattribution Properties of JPEG Quantization Tables" (2010). University of New Orleans Theses and Dissertations. 1261. https://scholarworks.uno.edu/td/1261

5.4.1.9 Katharotiya, Anilkumar. Patel, Swati. Goyani, Mahesh. Comparative analysis between DCT & DWT techniques of image compression. Journal of Information Engineering and Applications. Vol1, N0. 2, 2011

5.4.1.10 Mehala, R., Comparison of DCT and DWT in image compression techniques. International Journal of Advanced Research Trends in Engineering and Technology. Vol 3., Issue 20, April 2016.

5.4.1.11 Parmar, Himanshu M., Comparison of DCT and Wavelet based image compression techniques. International Journal of Engineering Development and Research. Vol. 2, Issue 1, 2014.

5.4.1.12 T.Prabakar Joshua, M.Arrivukannamma, J.G.R.Sathiaseelan. Comparison of DCT and DWT Image Compression. International Journal of Computer Science and Mobile Computing, Vol.5 Issue.4, April- 2016, pg. 62-67

5.4.1.13 Y. Sutcu, B. Coskun, T. Sencar, N. Memon. Tamper Detection Based on Regularity of Wavelet Transform Coefficients.

5.4.1.14 Jiyun Yang, Pei Ran, Di Xiao, Jinyong Tan. Digital Image Forgery Forensics by Using Undecimated Dyadic Wavelet Transform and Zernike Moments. Journal of Computational Information Systems 9: 16 (2013) 6399–6408

5.4.1.15 Steven Tjoa, W. Sabrina Lin, and K. J. Ray Liu. Transform Coder Classification for Digital Image Forensics. Dept. of Electrical and Computer Engineering, University of Maryland College Park, MD 20742 USA

5.4.1.16 Matthew C. Stamm and K. J. Ray Liu. Wavelet Based Compression Anti-Forensics. Dept. of Electrical and Computer Engineering, University of Maryland, College Park.

5.4.1.17 Y. Sutcu, B. Coskun, T. Sencar, N. Memon. Tamper Detection Based on Regularity of Wavelet Transform Coefficients.

5.4.2 Legal Support for Image Authentication

5.4.2.1 *United States v. Gutierrez*, 625 F. App'x 888 (10th Cir. 2015)(photographs properly authenticated based on metadata in child sexual abuse material prosecution).

5.4.2.2 *United States v. Hager*, 710 F.3d 830 (8th Cir. 2013)(Image authentication based on metadata).

5.4.2.3 *Tamares Las Vegas Properties v. Travelers Indemnity Company*, 586 F.Supp.3d 1022 (D.Nev. 2022)(photographs of roof taken by insured's contractor properly admitted in breach of contract action following denial of coverage based on photograph's metadata and associated stipulations).

5.4.2.4 *Bueno v. Benhamou*, 2022 WL 1592593 (CD.Cal 2022)(photographs properly considered in summary judgment adjudication of business litigation based on party opponent's authentication as well as metadata).

5.4.2.5 *United States v. Post*, 997 F. Supp. 2d 602 (S.D.Tx. 2014)(use of GPS coordinates in metadata to determine location where image was taken did not violate Fourth Amendment and could be otherwise admitted at trial).

5.4.2.6 John C. Depp, II v. Amber Laura Heard CL-2019-2911

Image authentication via metadata, showing it was imported into photo editing software.

5.5 Image Enhancement

Enhancement is any deliberate alteration that is intended to improve the visual appearance of an image or specific features within an image. This can be done to reveal information which is not visually apparent. There are multiple platforms and tools that can be used to conduct such enhancements. For further information on image enhancement, see the SWGDE document *Image Processing Guidelines*.

5.5.1 Academic Support for Image Enhancement

5.5.1.1 Praveen K. Chiluka, Sunil R. Das1, Mansour H. Assaf, Satyendra N. Biswas, Scott Morton, Emil M. Petriu, and Voicu Groza. Digital Wavelet Transform Based Image Forgery Detection Using Post-Processing. Society for Design and Process Science.

5.5.1.2 Johnson, M. K., Lighting and Optical Tools for Image Forensics. Dartmouth College.

5.5.1.3 Neal Krawetz. A Picture's Worth... Digital Image Analysis and Forensics. 2007 Hacker Factor Solutions, presented at Black Hat Briefings USA 2007.

5.5.1.4 Neal Krawetz. A Picture's Worth... Digital Image Analysis and Forensics Version 2. 2008 Hacker Factor Solutions, presented at Black Hat Briefings DC 2008.

5.5.2 Legal Support for Image Enhancement

5.5.2.1 *United States v. Seifert*, 445 F.3d 1045 (8th Cir. 2006)(discussing admissibility of image enhancement generally).

5.5.2.2 *United States v. Fisher*, 2022 WL 392597 (D.Montana 2022)(No. CR21-11-BLG-SPW (D. Mont. Feb. 9, 2022)(image stills are admissible as duplicates under Rule 1003 because they were produced by an electronic process and accurately reproduce the original despite enhancement).

5.5.2.3 *Commonwealth v. Auker*, 681 A.2d 1305 (Pa. 1996)(Chevrolet representative conducting a make/model examination with enhanced images properly admitted).

6. Conclusion

In conclusion, this document serves as a resource for image examiners navigating the complex realm of image-based forensic evidence in court. By addressing the most common examination requests and challenges, it equips forensic image examiners with the necessary knowledge and strategies to effectively present their qualifications, analysis methods, and reasoning behind their opinions. Furthermore, it acknowledges the limitations in creating statistical models for analysis and emphasizes the importance of complying with legal standards throughout the process. With the information provided in this document, image examiners will be well-prepared to confidently respond to the frequently encountered admissibility challenges they may face in the courtroom.

7. History

Revision	Issue Date	History
1.0 DRAFT	6/14/2023	Initial draft created.
1.0 DRAFT	9/19/2023	Draft for **INTERNAL REVIEW**
1.0 DRAFT	1/11/2024	Moved forward for SWGDE vote to release as a Draft for Public Comment
1.0 DRAFT	3/1/2024	Formatted for posting after SWGDE membership voted to release as a Draft for Public Comment.