



Digital & Multimedia Sciences - 2017

C7 Forensic Image and Video Enhancement: Methodology for Improved Efficacy and Error Mitigation

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After attending this presentation, attendees will develop an understanding of how the fidelity of image processing results can be profoundly impacted by the order in which image and video enhancement filters are applied. This presentation will entail discussion of commonly available forensic image and video enhancement techniques, fundamentals regarding their inner workings, and the complex interactions that can occur when multiple image processing techniques are applied in succession. Through this discussion and a series of practical examples, attendees will be prepared to evaluate a proposed order of operations for image enhancement, which seeks to maximize the effectiveness of forensic image enhancements while reducing spurious artifacts created throughout the image processing pipeline.

This presentation will impact the forensic science community by raising awareness of potential causes of image artifact creation and by offering methodology to mitigate such errors so that the best available information can be extracted from image data used in forensic investigations. The research presented will aid in the development of improved quality assurance standards for laboratories and individuals practicing forensic image and video enhancement. Furthermore, attendees who do not engage in image enhancement but are nevertheless impacted by the practice, such as law enforcement and legal professionals, will gain a better understanding of modern image enhancement techniques as well as their strengths and limitations.

Image enhancement is an accepted practice in the field of digital and multimedia forensics and heavily relied upon in many forensic disciplines, such as crime scene reconstruction, photogrammetry, questioned documents, and biometric analysis, including facial and fingerprint identification. Images used in these applications often undergo several concurrent image processing operations. It is significant to note that when multiple processing operations are applied to an image, like a falling stack of dominoes, each operation that an image undergoes will have an effect on any future processing on the image. Even when applying identical enhancement techniques, at the same exact settings, to the same image, applying them in the incorrect order can lead to an overall loss in image fidelity, loss of data, and the creation of features that are non-existent in the original image data, including artifacts such as image noise or false edges.

Visual components of digital images are, in principle, matrixes of numerical values. Image processing operations use algorithms to manipulate these numerical values mathematically. Since these algorithms operate in predefined ways, it is possible to predict their behavior. By studying the underlying processes of enhancement algorithms, it is therefore possible to predict how they react in relation to different image properties and thereby establish an ideal order for their application.

Currently, the digital and multimedia forensics community has not universally agreed upon the order in which image enhancements should be applied. Since the needs of every enhancement case is unique and can require different combinations of image processing operations and settings, it has often been seen as impossible, or at the least, impractical, to establish an order of operations for image enhancement. This presentation advocates that an order of operations for forensic digital image enhancement is both possible and readily applicable to forensic casework.

Image, Video, Enhancement

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