## D33 Forensic Image Processing

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The goal of this presentation is to provide an overview of forensic image processing techniques and the availability of open source software.

This presentation will impact the forensic science community by providing an introduction to forensic image processing that will raise analyst awareness of an increasingly important technology.

Surveillance video is nearly ubiquitous, from government, institutional, and commercial buildings to outdoor venues and unmanned aerial systems (drones). In many cases, the technology driving the development of video systems has far outpaced the acquisition of resources to aid the analysis of video imagery; however, familiarity with a few image processing concepts can often produce favorable results with video imagery that has been degraded by noise or improper lighting. Other image processing algorithms can be used for feature enhancement or data fusion. Also, open source image processing software is available and has many functions applicable to forensic image processing.

Digital filters are powerful algorithms that can be used for both noise suppression and feature enhancement. Low-pass filters, for example, can block high-frequency image components, such as internal noise or lighting artifacts. High-pass filters behave in the opposite manner, enhancing high-frequency components that produce an edge-sharpening effect. Most open source image processing software includes standardized low- and high-pass filters, plus the capability to design custom filters.

Another powerful image processing technique involves enhancing the pixel brightness histogram. When a video frame has been degraded from adverse lighting, too bright or too dark, pixel brightness values can be redistributed to partially correct for such adverse lighting effects. These histogram enhancement techniques, collectively referred to as a linear histogram stretch, are suitable for both black-and-white and color images. When a video frame has areas that are too dark and also too light, a non-linear histogram stretch can be applied. Almost all open source image processing software includes histogram-stretching functions. In addition to histogram stretching, there are a variety of related histogram-enhancement functions; most of them are easy to understand and implement.

Digital filtering and histogram enhancement can be considered suitable techniques for image restoration. A separate category of forensic image processing is feature extraction. While the process of image restoration is guided by an analyst, feature extraction can be automated to some degree. For example, in a case in which a video surveillance system is used to detect the presence of a feature, such as a vehicle or a person, classification techniques can process a series of video frames to detect the feature of interest. Similarly, image transformations, such as principle components, can be effective for separating image features based on their relative reflectance.

The availability of open source software, coupled with a basic familiarity with image processing techniques, enables analysts to gradually increase their forensic image processing skills. Given the abundance of deployed video surveillance systems, along with law enforcement body cams and drone video, demand for forensic image processing expertise can only increase.

**Digital Video, Image Processing, Video Surveillance**



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