Article

Optimized Digital Recording of Crime Scene Impressions

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Introduction

The evidence photographer is faced with a wide range of photographic challenges at crime scenes. Recording crucial evidence in the form of fingerprints, shoeprints, or other impressions is often problematic. These images may be extremely fragile as well as difficult to see. The background color or texture can easily overpower subtle detail. Curved, specular, or uneven surfaces may resist attempts to record all of the detail in one exposure. Lastly, exhibits bearing evidence can often be difficult or impossible to remove from the scene for photography in a controlled environment, without risking damage to the evidence.

In most circumstances, conventional photographic procedures are used successfully to record such evidence discovered at crime scenes. The experienced photographer may employ oblique, tent or coaxial lighting, tilt and swing camera movements, or polarizing and contrast filters to obtain a suitable recording.

Digital evidence enhancement techniques, such as Fast Fourier Transform and Image Subtraction, have been described previously in detail. It is not the purpose of this study to reiterate those descriptions or to report case results, but rather to recommend specific procedures for the maximum recovery of evidence when analog techniques are suspected to fall short. The successful application of computer technology depends on the technician recognizing the potential of these procedures and

following the required necessary steps in recording images at the scene.

Four situations, based on the collective case experience of the authors, were re-created to explore the effectiveness of digital techniques, the application of which depends on recordings taken at the scene in specific order and procedure. Although the images acquired in this study were transferred to a desktop computer for processing, the same results could have been obtained on a laptop computer at the scene. Resulting digitized fingerprints can be forwarded for AFIS search with minimum delay.

Equipment

All images were captured with a Nikon D-1 digital camera. The images were captured as 24 bit RGB images in a TIF format (lossless) and were 7.56 MB in size. The resulting images were processed using Image-Pro Plus, Version 4.1. The image subtractions were completed while the images were in TIF format. The images were lastly converted to 8-bit gray scale JPEG images for ease of transmission and publication.

Image subtractions were completed with the color images. It is significant to note that if the images are converted to gray scale prior to the subtraction, an entirely different and greatly inferior result may be obtained. It is also significant that other examples, prepared in identical fashion, were unsuccessful in revealing additional detail.

Scenario One

A dust shoeprint was deposited on the cloth surface of a chair. Similar impressions have also been discovered on rugs and other fabric surfaces at crime scenes. The fabric caused obstruction of the impression both in surface discontinuity and in color pattern. This type of evidence, routinely encountered at break-and-enter scenes, is extremely fragile and may be lost or degraded by the removal, or even jarring movement, of the chair. In actual case applications, it is strongly recommended that the impression be recorded by conventional photography to the extent possible, before the digital recording process is started.

A scale was placed beside the impression. A Nikon D-1 was placed on a tripod over the chair, and an image was recorded (Figure 1a). Without changing the position of the camera, the lighting, or the chair, the scale was removed, and the impression was vacuumed, with care taken to avoid movement of the chair or fabric. A second image, in register to the first, was taken.

The images were later downloaded to a desktop computer, and a background subtraction was performed (Figure 1b). The image was inverted and was adjusted for contrast (Figure 1c).

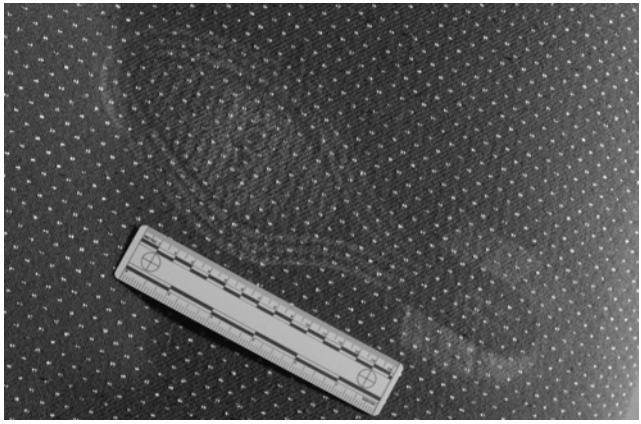

Figure 1a

Image of dust shoeprint on chair.

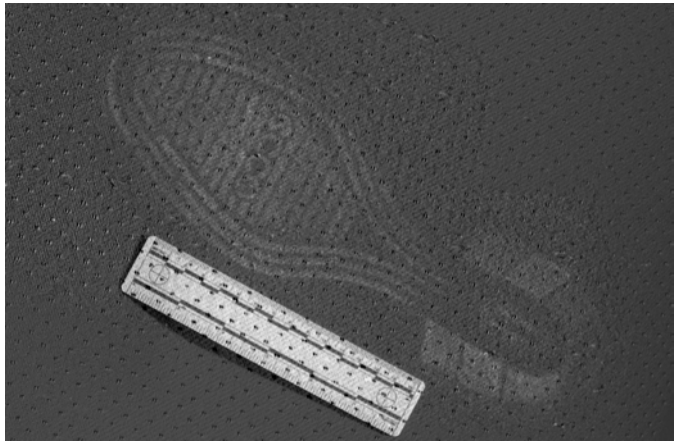

Figure 1b

Image after background subtraction.

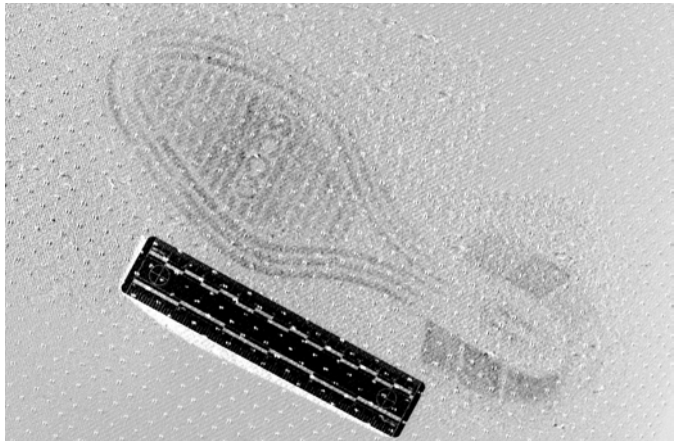

Figure 1c

Image inverted and adjusted for contrast.

Scenario Two

Fingerprints were placed on patterned wallpaper and treated with ninhydrin, in re-creation of an actual homicide scene examined by two of the authors. In such situations, the wallpaper is frequently the non-strippable variety, and it must be examined in situ.

A scale was placed beside the resulting impression and the impression was recorded using the Nikon D-1 (Figure 2a). Without altering the relationship of the camera to the image plane, the scale was removed and the fingerprint was erased by the application of a mild solution of bleach (20%) with a cotton swab. After allowing the surface to dry, a second image was captured.

As in the previous situation, this second image was subtracted from the first (Figure 2b). The resulting image was adjusted for contrast and was processed with Fast Fourier Transform to improve clarity of ridge detail and to suppress background interference (Figure 2c).

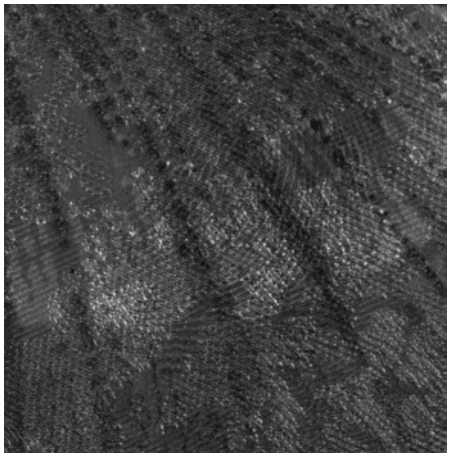

Figure 2a

Image of ninhydrin prints on wallpaper (image cropped to subject).

Figure 2b

Image after background subtraction.

Figure 2c

Image adjusted for contrast and processed with Fast Fourier Transform.

Scenario Three

A fingerprint was deposited in grime on patterned wallpaper to emulate visible dirt impressions where chemical development is not required or possible. A digital recording of the impression and scale was obtained with the Nikon D-1 (Figure 3a). The fingerprint was then erased with a damp swab, preserving the register of camera to subject. When the surface had dried, the scale was removed and a second image was obtained, which was subsequently subtracted from the first image (Figure 3b). The resulting image was adjusted for contrast and was processed with Fast Fourier Transform to improve ridge clarity (Figure 3c).

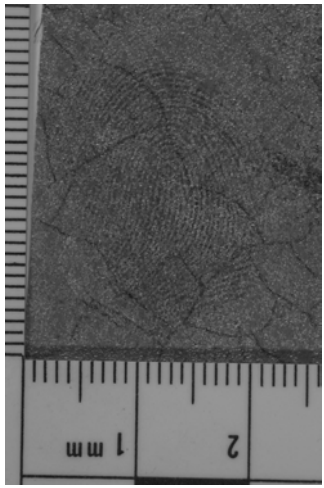

Figure 3a

Patent fingerprint on wallpaper.

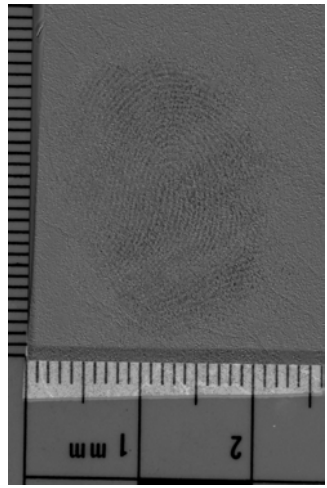

Figure 3b

Image after background substraction.

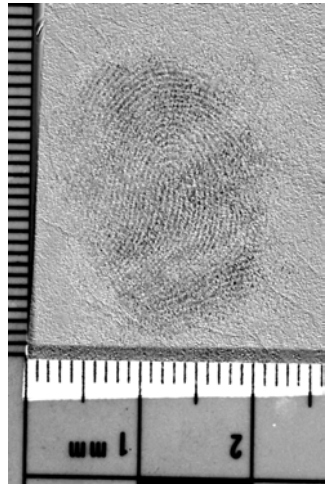

Figure 3c

Image adjusted for contrast and processed with Fast Fourier Transform.

Scenario Four

A fingerprint was developed on patterned wallpaper with ninhydrin, similar to scenario two (Figure 4a). The detail was observed to be distinct in some areas, but was interrupted by the pattern of the wallpaper. The ninhydrin fingerprint was erased as previously described in scenario two, and a second image was recorded. After image subtraction (Figure 4b), detail was revealed in the obstructed area which resulted in a much larger area of continuous ridge detail. The image was adjusted for contrast (Figure 4c).

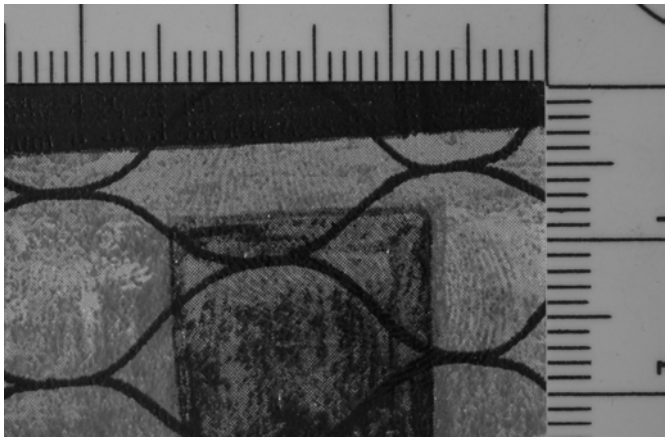

Figure 4a

Ninhydrin developed fingerprint on wallpaper.

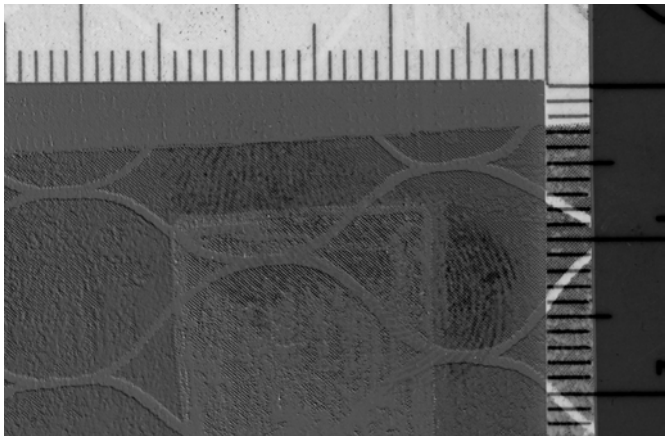

Figure 4b

Image after background subtraction.

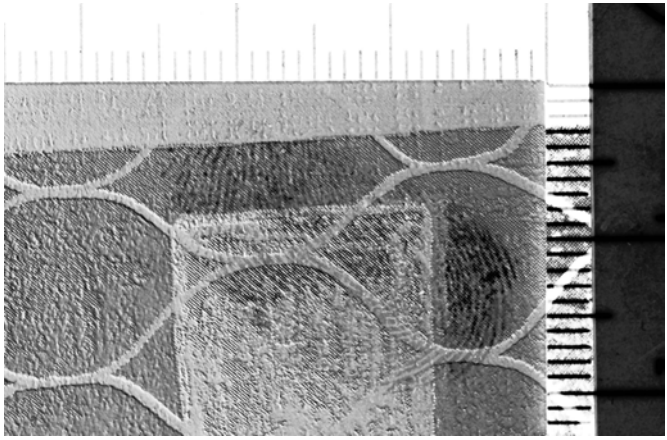

Figure 4c

Image adjusted for contrast.

Conclusions

1. It can be noted in each of these created scenarios that the potential exists for extracting more information with the application of a computer technique (subtraction) than was possible with photography alone. The interest is in recommending a combination of techniques that may result in a net gain in the quality of recovered evidence.

2. As a subtle difference from some previous recommendations on digital image processing, and in the situations cited here, the computer techniques are not merely an extension of photography, when it fails to deliver a suitable image, but are an integral part of the initial capture. Furthermore, the opportunity to employ them, as described herein, may only exist at the crime scene.

3. In the spirit of obtaining "best evidence", it is necessary to obtain photographs or images documenting the minute detail in the evidence before trying the erasure method. It is recommended that conventional photographs be included in this documentation.

4. The authors are not recommending or negating a total transition to digital crime scene recording. If the operational protocol of an agency is based on conventional photography, the techniques outlined herein should be regarded as ancillary. The implications of employing digital imaging exclusively fall outside the purview of this study.

5. There exists the potential for a significant saving in time by application of these digital recording and enhancement techniques in obtaining an image ready for AFIS search and/or suspect comparison.

6. The net gains in signal to noise ratio need not be as obvious as those achieved in the examples illustrated herein. An enhanced latent print resulting in more clarity and contrast than originally captured can aid a fingerprint examiner in concluding whether an identification can be effected.

7. A single finger impression may consist of isolated areas of ridge detail that are distinct and continuous, but lack sufficient detail independently upon which to base a conclusion of either elimination or identity. If the areas between these areas can be clarified so that the continuity of the ridges is unbroken, a significant opinion may be formed that would otherwise have not been possible.

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