Chapter 8
Forensic Camera Identification in Social Networks via Camera Fingerprint

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ABSTRACT

Image-related crimes cause the urgent demand for tracing the origin of digital images. The breakthrough is a passive detection method via photo response non-uniformity (PRNU) analysis proposed by Lukáš et al. Recently, digital images are often shot with handheld devices (such as smartphones) and transmitted using social media (such as LINE). Most of the images are distorted (such as compressed and resized) during transmission. Previous studies are less focused on the impact of transmission compression through social networks. Thirty-one different Apple mobile phones were used to capture digital images in the experiment. Images were uploaded to the photo album via LINE software and then downloaded. The modified signed peak correlation energy (MSPCE) statistics is used to evaluate the correlation between the PRNU values of the disputed images and the pattern noise of the experimental devices. Experimental results show that the PRNU analysis method can effectively trace the source of the shot device using the distorted images which are compressed and resized during the transmission in LINE.

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INTRODUCTION

Due to the wide use of mobile phones, the acquisition of an image is simple. In addition, the rise of convenient social media has made communication using images easier. Consequently, some illegal information such as obscene pornography, personal privacy, and national security-related content has been released to the public by images or videos.

To incriminate the criminal behavior of these suspects who created illegal images, it is important to identify that these images were taken from devices owned by these suspects. Kurosawa *et al*. (1999) were the first investigators to propose the source camera identification (SCI) technique. From the study, the non-uniformity noise or defects can be retained in the charge-coupled devices (CCDs) in the photosensitive element manufacturing process. It can be used as a fingerprint as bullet scratches to match a bullet identity in forensic science. They performed SCI experiments with 9 camcorders in 4 types by using dark current on CCD chips and obtained 8 fixed pattern noises from 9 camcorders. However, they used the dark current noise which is a signal collected from the sensor when it is not exposed to light. Dark current is only extracted from dark frames. This limits the method because camera identification is not possible from non-dark frames. The mainstream of traceability technology for digital imaging equipment is the passive detection and traceability analysis of photo-response non-uniformity noise (PRNU) published by Lukas *et al*. (2005a, 2005b, 2006). The PRNU is caused by different sensitivity of sensor pixels to light. They (2005a, 2005b) used the Daubechies 8 wavelet (db8) filter to estimate PRNU and used the correlation coefficient for digital camera sources to make a comparison of 9 types of different digital cameras and 2 kinds of file formats (TIFF and JPEG). In Lukas *et al*. (2006), they updated the wavelet filter (Mihcak *et al*., 1999) as the denoise filter, and used different Gamma correction coefficients and compression ratios to analyze the sensor pattern noise in 9 different digital cameras. This technology has been used in child rape convictions in Scotland (Spy Blog, 2009) and applied to various international technical specifications (Scientific Working Group on Digital Evidence, 2018). Yang *et al*. (2021) considered the camera rolling problem and reduced the false positive rate as compared to existing methods used in the field of forensic examination.

Recently, the disputed images obtained from criminal investigations are often digital images transmitted through social media. It is worth exploring whether the PRNU analysis technology can still be efficiently used to trace the source of the shot device.