C16 Source Camera Comparison Using Photo Response Non-Uniformity (PRNU) on WhatsApp

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After attending this presentation, attendees will be aware of the possibilities and limitations of PRNU on WhatsApp.

This presentation will impact the forensic science community by illustrating how the use of PRNU on images transmitted with WhatsApp can be used even if the file is converted. Depending on the version of the operating system and app, the PRNU will be filtered and a weaker conclusion can be given.

In digital footage, different types of noise, such as dark current, reset noise, circuit noise, and PRNU, are present. PRNU is caused by the imperfection of the camera sensor created during the manufacturing process. Not every pixel of the sensor is identical and will, therefore, respond differently to the same amount of light. This is called the non-uniformity of pixels. When the camera sensor, for example, will be illuminated equally, not all pixels will measure the same amount of light. This is caused by the difference of the sensitivity of pixels to light. Over the sensor surface, this creates a pixel non-uniformity pattern which is called the PRNU pattern. Because the PRNU pattern originates from the camera sensor, the pattern will be present in all footage taken with this camera sensor. The PRNU pattern is specific for a camera sensor and is also called the fingerprint of a camera.[1-3]

To determine if a video is created with a specific camera, the PRNU patterns from the disputed video and the disputed camera are needed. Using software, the PRNU patterns can be extracted from a video. The first step of the extraction is to average groups of individual frames of the video. A parameter, the frame averaging rate, can be set to determine how many frames per group will be averaged. For example, a video with a thousand frames will be averaged with a frame-averaging rate of ten. Per ten frames, an averaging will be determined that delivers a hundred averaged frames in total. The second step is to extract the noise per averaged frame. Research has shown that better results were made with the second order (FSTV) filter.[3] With this filter, the noise will be removed from the footage. By subtracting the averaged frame without the noise from the averaged frame with the noise, the noise pattern will be obtained. Then, as the third step, the noise patterns from all the averaged frames will be averaged. With this step, noise that is not present in every frame, like the PRNU pattern, will be restrained and the PRNU pattern becomes clearer. Due to electronic imperfections, some rows and columns of pixels can be systematically brighter or darker. This noise can be removed with step four by using a zero mean filter.[4] The last step in the extraction method is to remove artifacts created due to compression. Groups of pixels that share information to reduce data size create a pattern over the surface of the footage. To remove this pattern, a Wiener filter is used. Finally, the PNRU pattern is as clear as possible.[4]

To obtain the PRNU pattern from the disputed camera, a reference video is needed. These reference videos are called flat field videos. A flat field video is taken by moving the camera over a gray surface. By moving the camera over a grey surface, the camera sensor is illuminated as equally as possible and no objects will be present in the video. This causes the PRNU pattern to be as clear as possible.

When the PNRU patterns from the disputed video and the disputed camera are extracted, the two PRNU patterns can be compared. This can also be accomplished by using PRNUCompare. PRNUCompare compares the patterns and calculates the Peak to Correlation Energy (PCE).

In this research, cameras of different Android® brands as well as iPhones® were used. The PCE is lower after transmission with WhatsApp. With several phones from Samsung™ and Huawei, the likelihood ratio is low. With other cameras, a higher conclusion in likelihood ration can be drawn. The video material is re-encoded by WhatsApp and, with some cameras, the PRNU is no longer available with the method used. With the Apple® iPhone®, the PRNU pattern remained and a conclusion could be drawn if the video was created with the same source camera.

Reference(s):

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WhatsApp, PRNU, Source Camera Comparison

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