C19 Questions About the Integrity and Authenticity of Digital Images: A Review of Case Reports From the Netherlands Forensic Institute

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This presentation will impact the forensic community and/or humanity by developing standard operating procedure for determining the authenticity and integrity of a digital image file.

For forensic casework the question of authenticity has to be answered if a certain image has allegedly been made with a specific digital camera. Another question that may be asked is if two images have been made with the same camera. In order to answer this question pixel defects, and information from the headers and footers of image files can be used. Furthermore, the method of examination of pixel defects combined with headers and footers is useful for integrity research: finding traces of manipulation (e.g. cut and paste) of the images.

A digital image is composed from a matrix of pixels (picture elements). For capturing a digital image a Charge Coupled Device (CCD) is used in a camera. When manufacturing large CCD arrays, they sometimes contain defects. A defect is visible in the image as a pixel defect if the CCD element has a different light sensitivity compared to the surrounding CCD elements.

For the examination of pixel defects the authors have developed a standard operating procedure in forensic casework. The examination has two approaches. If the camera is available, test images will be made with the camera with a white, gray, or a black surface. These images are used as a reference set. If the camera is not available, one set of images is used as reference set.

In some casework the pixel defects could be visualized without averaging or image processing, since they were visible in the images themselves without any processing. However, for visualizing the pixel defects it is often necessary to add and average the intensities of the images. As a result of this, fluctuations in the images due to the image itself will be averaged. In order to visualize the pixel defects a filter, for instance a median filter can be used.

The locations of the pixel defects in the reference images are compared with the location of the pixel defects of the questioned images. If the locations of the pixel defects agree with each other, this provides strong support for the hypothesis that they have been made with the same camera. The conclusions are not quantitative however, since not enough statistical data is available from the randomness of pixel defects.

Conclusions from pixel defects are reported as level of support to the hypothesis that an image has been acquired with a specific camera, and/or the level of support to the hypothesis that the have been acquired by a different camera. The following levels of support can be given: no support, limited support, moderate support, strong support, and very strong support. In cases with similar support to both hypotheses, no conclusion can be drawn due to discrepancies.

Header and footer-information is often available in the digital files received. The information in the headers and footers is not visible in the image itself, however by using software (for example a hex viewer) the information can be made available. In JPEG images from cameras this information often provides camera settings and brand and type of the camera itself, and sometimes provides information with which software the image has been edited. It is possible to modify the header and footer information by using software, so for forensic casework the examiner has to be aware of this possibility before drawing conclusions. If the header provides information that the image has been taken with a specific camera, it is possible that someone has altered the contents of this header, and that the picture actually has been taken with a different camera.

The results of examining pixel defects can be combined with information from the headers and the footers, for determining the integrity and authenticity of images. Several cases that have been received will be discussed in the presentation, and a review is given of the results reported.

Image Processing, Pixel Defects, Standard Operating Procedure