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Digital Image Authentication, Digital & Multimedia Sciences, Image Manipulation Detection

 ** Presenting Author*

B14 Identification of Cameras With Photo Response Non-Uniformity (PRNU) in Large Databases

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After attending this presentation, attendees will be aware of the possibilities of linking a certain image to a specific camera in larger databases.

This presesntation will impact the forensic science community by discussing validation of techniques in large scale databases.

Photo Response Non-Uniformity pattern is a unique sensor noise pattern that is present in all the images and videos produced by a camera, as it originates from intrinsic sensor properties.

This sensor noise pattern acts as a fingerprint, and this fingerprint essentially represents the deviation of each pixel with respect to the average pixel response at uniform illumination. This noise pattern is a stable pattern, which makes it a good candidate for linking a certain image to a certain camera. In each case validation is needed to determine if the patterns are really random, which means the creation of flat field images from at least ten cameras of the same make and model. Flat field images are images taken from a gray surface where no edges are visible.

Indeed, large scale testing on photo cameras has shown that it is possible (with low false acceptance and false rejection rates, or a high likelihood ratio) to identify the source camera based on the patterns that were extracted from images. In general, the amount of compression present in photos is much less severe than what is encountered in videos, especially if they originate from webcams or mobile phones.

The compression effectively acts as a low-pass filter, thus removing or attenuating the PRNU pattern. Another problem is that these devices have in general a much lower resolution and visual inspection already signifies the high amount of compression artifacts present. On the other hand, multiple frames are available from which an average noise pattern can be calculated, which alleviates some of these problems.

Also, these low-cost devices may have a stronger PRNU pattern compared to full size digital cameras, which adds to the feasibility of identification. Previously seen in small scale tests that under certain conditions it is also possible to correctly identify the source video camera, even for heavily compressed webcam videos obtained from YouTube. It is expected that these low quality webcam videos behave similar to videos shot with mobile phones, and hence may also be very useful in a forensic context.

For testing PRNU on larger databases a framework for comparison has been developed, which is open source and can be downloaded from http://sourceforge.net/projects/prnucompare/ .

One of the problems encountered with these low quality cameras is that these compression artifacts (seen as square DCT blocks in the extracted patterns) cause high correlations to occur between unrelated cameras. This stresses the need for large scale testing. However, large scale tests are tedious to perform, mainly due to the long calculation times needed for extracting the noise pattern from the videos, and the lack of online video databases with known source (similar to Flickr for photos). With the advent of an online pattern database, there is hope to overcome both these problems. This allows larger scale testing, and hopefully the ability to make predictions about the reliability of the method applied to these low resolution cameras in practice.

In forensic reports, the error rates of the method are also considered, and will conclude within the Bayesian approach.

Photo Response Non Uniformity, Likelihood Ratio, Camera Identification

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