Generation Of Iris Sensor PRNU Fingerprints From Uncorrelated Data

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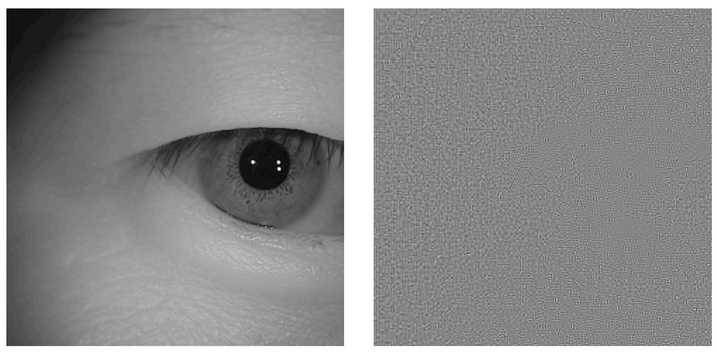
Abstract

The photo response non-uniformity (PRNU) of a sensor can be used for various forensic tasks, such as source device identification, source device linking, classification of images taken by unknown cameras, integrity verification, authentication. To ensure good results a high quality PRNU fingerprint of the sensor is needed. This can be achieved by acquiring images with uncorrelated content and high saturation, which are then used to calculate the fingerprint. Generating the desired data with iris sensors is not trivial, since they mostly have limited configuration options. These limitations come either by the sensor itself or by the software used to acquire the data. We describe how the desired images can be acquired with different iris sensors and illustrate the challenges and problems faced during the acquisition process. Finally the impact of the PRNU fingerprints calculated from the uncorrelated data on the device identification results is evaluated in respect to the usage of correlated data.

Acquisition of uncorrelated iris sensor data for PRNU fingerprint generation

Sensor fingerprints, a methodology used in digital image forensics, are based on a sensor's photo response non uniformity (PRNU). They provide image integrity and also authenticity by identifying the source sensor uniquely, even various sensors from the same brand and model can be distinguished.

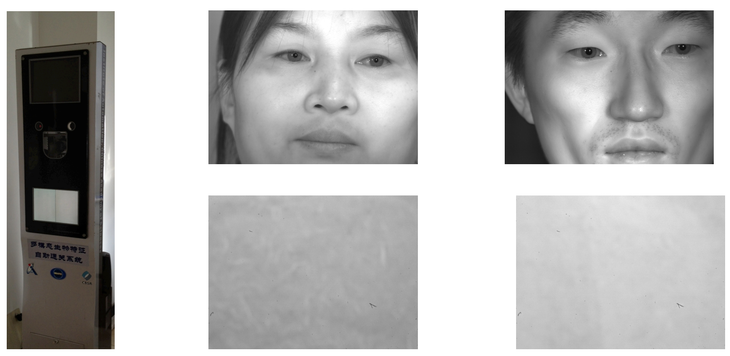


Sample from the CASIA Iris V4 Database and the extracted PRNU

Images with uncorrelated content and high saturation are needed to obtain a high-quality estimate of the sensors fingerprint. The best images for estimating the fingerprint are those with high luminance (but not saturated) and small σ^2 (images with a smooth content).

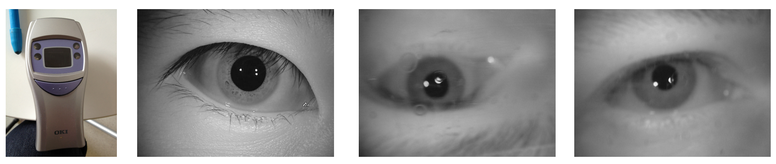
The sensors used for the acquisition of uncorrelated data are the *CASIA long-range iris camera*, *OKI IRISPASS-h*, *Irisguard AD100* and *Irisguard H100 IRT*. To capture the data different materials, like paper sheets and plastic foil, were used to obtain uncorrelated out-of-focus images with high luminance.

CASIA long-range iris camera



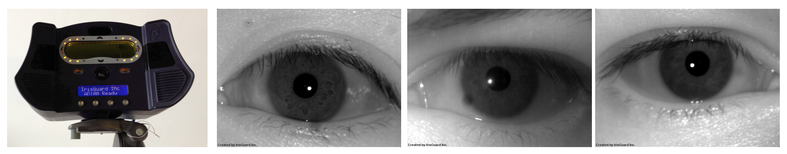
Examples from CASIA-Iris-Distance data set and from the uncorrelated data acquisition for the CASIA long-range iris camera.

OKI IRISPASS-h



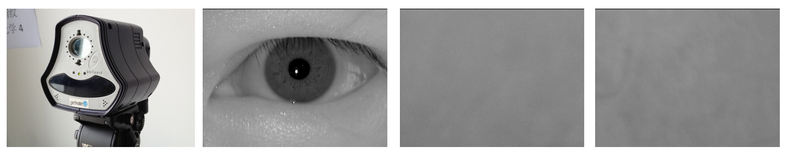
Examples from CASIA-Iris-Lamp data set and from the uncorrelated data acquisition for the OKI Irispass-h sensor.

Irisguard AD100



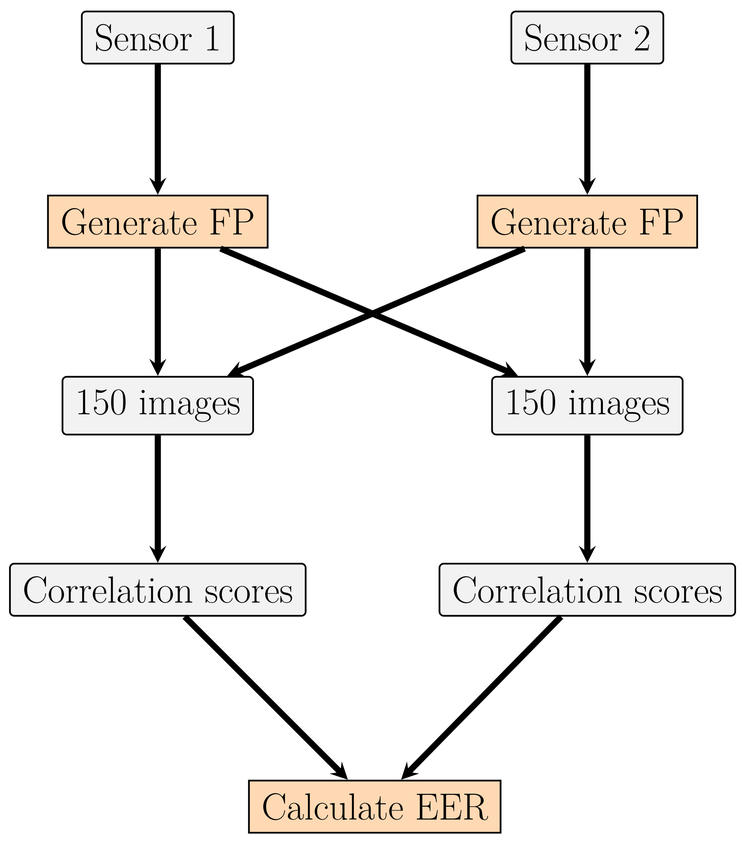
Examples for the the Irisguard AD100 sensor and attempts to circumvent the quality assessment.

Irisguard H100 IRT



Examples of images acquired images with the Irisguard H100 IRT sensor.

Experiments



From each data set 180 images have been randomly chosen: 30 to calculate the PRNU fingerprint and 150 to calculate the correlation scores.

This leads to 150 matching and 5x150 non-matching correlation scores for each sensor. From this correlation scores the EER was calculated for each sensor pair S_i and S_j, where $i \neq j$.

The steps described above have been repeated twice, first with the PRNU fingerprints generated using images from the respective data sets and then with PRNU fingerprints generated using the uncorrelated data acquired for the sensors *OKI IRISPASS-h (1)*, *CASIA long-range iris camera*, and *Irisguard H100 IRT*.

CASIA Iris V4 experiment

EERs for *correlated* data:

Data set	Interval	Lamp	Twins	Distance
Thousand	24.67	14.67	4.33	5.33
Distance	17.67	11.33	1.33	
Twins	17.67	15.33		
Lamp	25.33			

EERs for *uncorrelated* data:

Data set	Interval	Lamp	Twins	Distance
Thousand	24.67	23.67	4.33	49.17
Distance	52.33	58.17	46.00	
Twins	17.67	24.83		
Lamp	30.83			

Abs. differences (*correlated*, *uncorrelated*):

Data set	Interval	Lamp	Twins	Distance
Thousand	0.00	+9.00	0.00	+43.84
Distance	+34.66	+46.84	+44,67	
Twins	0.00	+9.50		
Lamp	+5.50			

2013 iris data sets experiment

Data set pair	Irispass-2013 , H100-2013
EER corellated data	0.00
EER uncorellated data	0.00
CI corellated data	(0.00-0.00)
CI uncorellated data	(0.00-0.00)
EER absolute difference	0.00

Conclusion

The use of uncorrelated data to generate the fingerprint yielded to an increase of the EER for the respective sensors, varying from negligible increase of 0-1% to an increase of up to almost 50%.

Because it is not verified whether the CASIA data sets have been acquired each with a single sensor or if they have not, it is difficult to interpret the results, but hints have been found that the latter could apply. It is also possible that the usage of uncorrelated data does not bring any benefit in this case because the estimated fingerprints have already been accurate enough.

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