

## Analysis of Images Correlation Matrix for Forensics Applications

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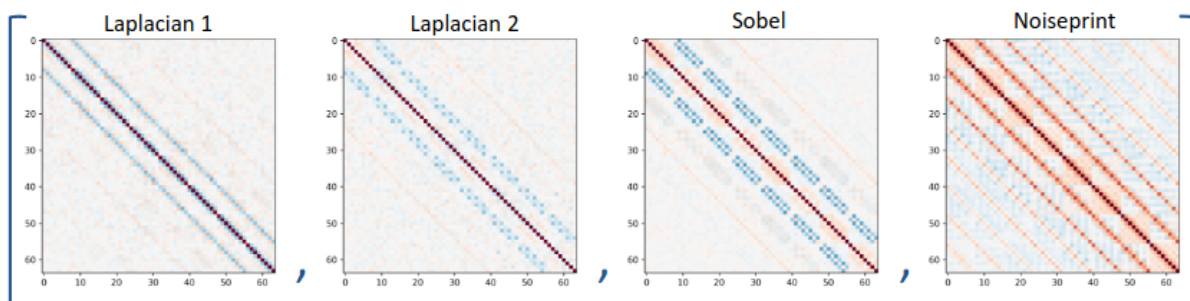
**Keywords:** Image processing · Security · Image forensics · Statistical analysis

Recent works on the analysis of the source of a natural image show that the acquisition and processing pipeline have an impact on the nature of the noise present in the resulting images. This impact is particularly visible in the correlation of neighbouring pixels. We present here an exploratory study based on correlations of the noise of developed images. Several noise estimations are studied, as well as different source identification strategies.

Particularly, we compare the estimations based on basic Laplacian and Sobel high-pass filtering with much more sophisticated approaches, namely [1]. To ensure an estimation of the correlation of the noise, we apply a threshold on 8x8 blocks of the image to retrieve the smoothest parts of the filtered image. Examples of correlation matrices are given in Figure 1. We first show that we can perform source identification based on a clustering algorithm using similarity measurements between correlations. We showed, by looking at the confusion matrix, that correlations bear information about the different operations applied. This method, however, performs worse than an Ensemble Classifier [2] based method based on the DCTR feature [3]. Similarly, as shown in Table 1, the Ensemble Classifier (EC-CLF) used only on single correlations still bear underwhelming results. However, as can be seen in Table 1 and Figure 2, we showed that this method performs better when trained on features built using the correlation coefficients from the multiple filters simultaneously.

*Table 1: Image source identification accuracy (in %) , using EC-CLF*

Laplace1	Laplace2	Sobel	Noiseprint	Combined	DCTR
63,7	65,2	63,7	71,1	86,2	83,5



*Figure 1: Correlation matrices obtained for each filtering method.*

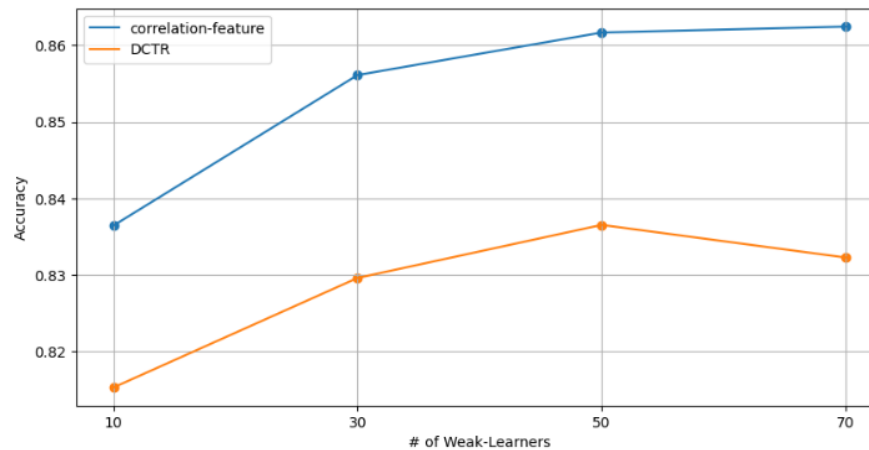


Figure 2: Detection rate of EC-CLF with DCTR and combined correlations, for different hyperparameter values

## References:

- [1] “Noiseprint: A CNN-Based Camera Model Fingerprint”, D. Cozzolino et al., *IEEE TIFS*, 2020, doi: 10.1109/TIFS.2019.2916364.
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- [4] “Low-Complexity Features for JPEG Steganalysis Using Undecimated DCT”, V. Holub et al., *IEEE TIFS*, 2015, doi: 10.1109/TIFS.2014.2364918.

## Additional information

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### Topics of research:

Image processing and security