Task 3

Using the PRNU Fingerprint

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Let us make own experiments with PRNU fingerprinting. We can use a subset of the popular "Dresden Image Database". The images are stored in the CIP pool directory `/proj/ciptmp/sichries/dresden_db_2_models_6_devices/`. The naming scheme of the images is `(camera_model)_(device_number)_(image_number).JPG`. You will find two devices of `Canon_Ixus70`, and four devices of `Casio_EX-Z150`.

Use the PRNU processing pipeline to distinguish images from different devices.

1 Extracting the PRNU fingerprint

Use at least 50 images from one device for fingerprint extraction. To this end, you need to average the residuals of each image. If memory or processing time are an issue, then it makes sense to crop a center region from each image (e.g., 1024×1024 pixels — but take care that you grab the same pixels from each image, otherwise your fingerprint extraction will fail.

When calculating the residuals, it is certainly helpful to truncate large residuals. Note that the quality of the fingerprint directly depends on the quality of the denoiser. For the purpose of this exercise, feel free to use a simple denoiser.

2 Fingerprint Detection

Calculate the fingerprint on unseen images from the same device and different devices.

Do not directly use the raw correlations. Instead, calculate the peak to correlation energy ratio (PCE). The PCE is

$$\text{PCE}(\mathbf{s}, \hat{\mathbf{f}}) = \frac{\rho\left(\mathbf{s}(0,0), \hat{\mathbf{f}}\right)^2}{\frac{1}{8} \sum_{\substack{i,j=-1 \\ (i,j) \neq (0,0)}}^{1} \rho\left(\mathbf{s}(i,j), \hat{\mathbf{f}}\right)^2} \quad , \tag{1}$$

where $\hat{\mathbf{f}}$ denotes the fingerprint, $\mathbf{s}$ the residual of the unknown image, the indices of $\mathbf{s}$ denote a pixel shift in x- and y-direction, and ρ is our correlation operator.

Hence, You can either crop or circularly shift the fingerprint for this calculation. The advantage of this metric is that it better normalizes for accidental correlations between images.

Plot the PCE values for same and different devices in two different colors. How good is your (empirical) device separation?