Technical Report - 1: Computing the SNR

Scene Segmentation and Interpretation

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Summary:

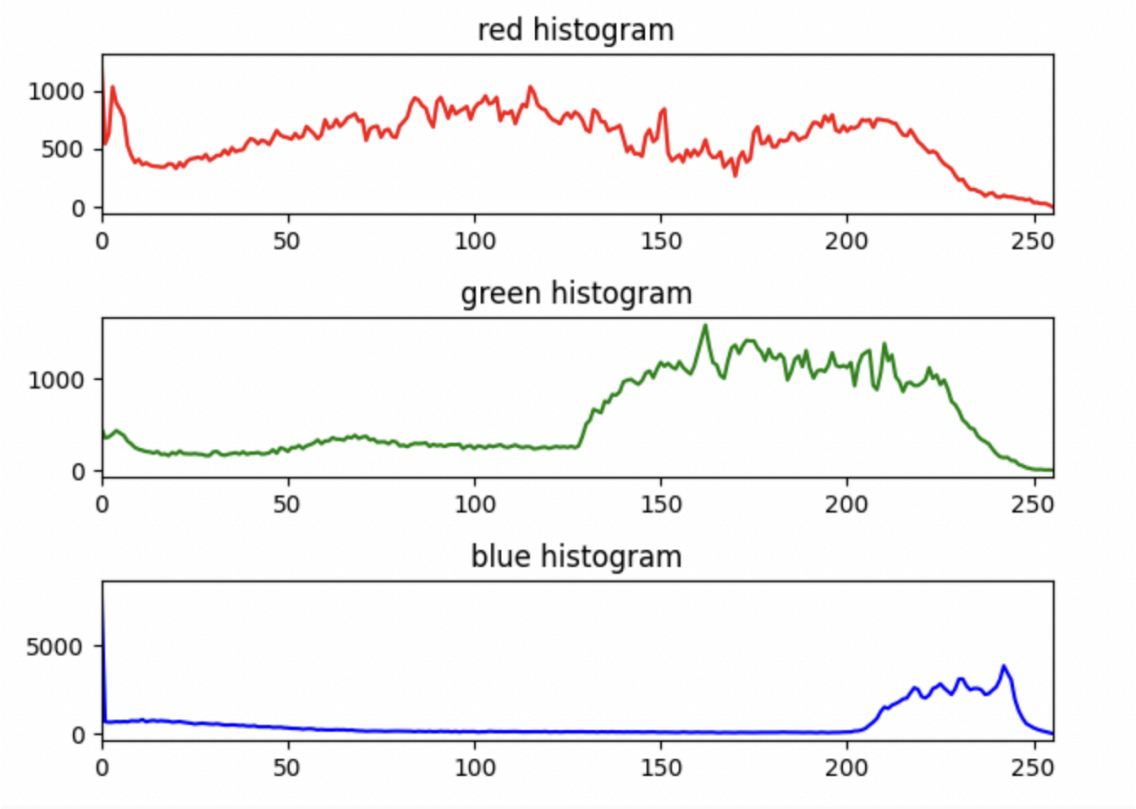
This technical report aims to outline the procedure for calculating the Signal-to-Noise Ratio (SNR) in a color image. It encompasses steps like image preprocessing, noise generation, analysis, and evaluating the influence of smoothing filters on SNR. The goal is to present the methodology and findings in a straightforward and succinct manner.

1. Choose a color image (max size 512x512), resize the image is necessary:

Choose a color Image with a maximum size of 512 X 512 pixels.

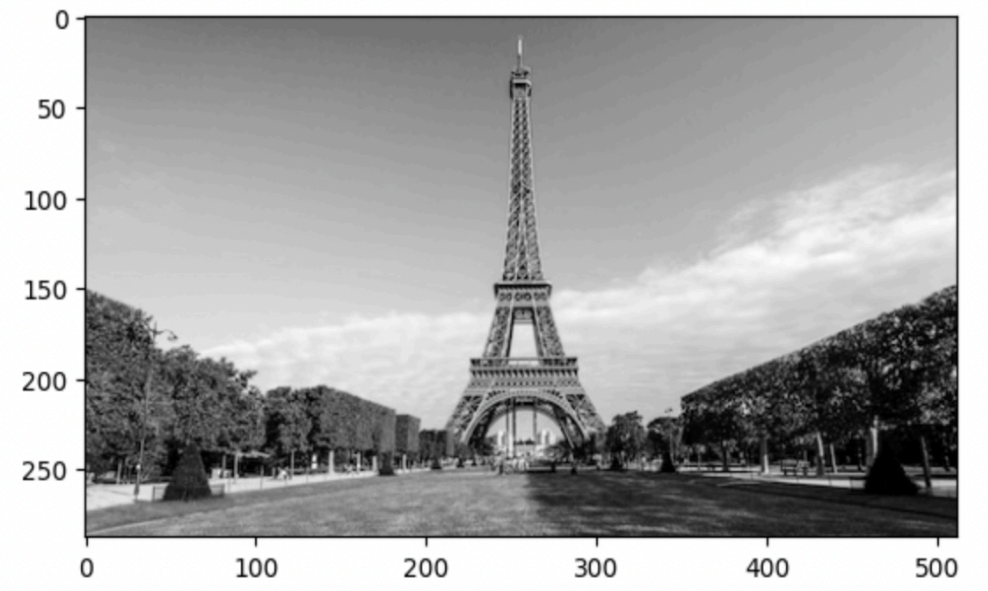
2. Display the histogram of the three channels.

Histogram of the RGB Channels:

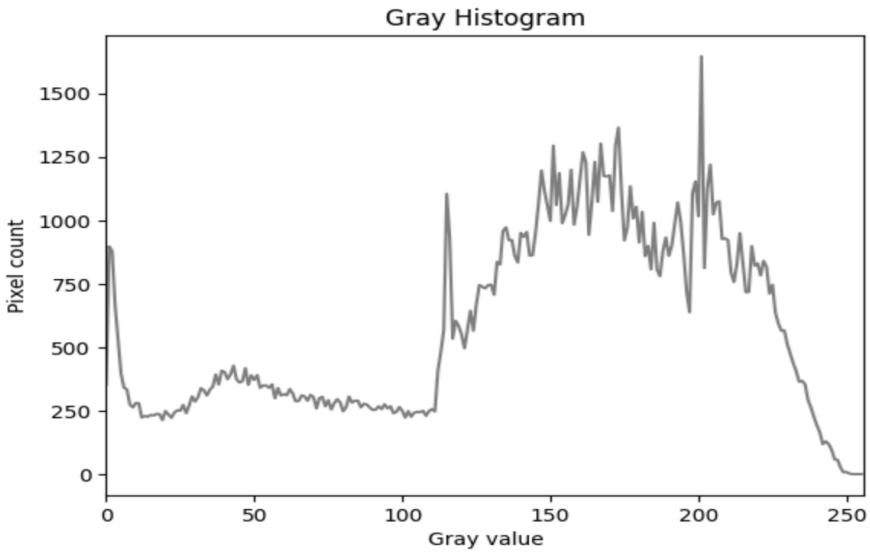


3. Convert the image into grayscale level by averaging the three channels RGB.

```
red = img[:,:,2]
green = img[:,:,1]
blue = img[:,:,0]
Average_Gray = blue/3+green/3+red/3
plt.imshow(Average_Gray, cmap='gray')
```



4. Display the histogram of the grayscale image. Extract the minimum and the maximum of the grayscale levels.



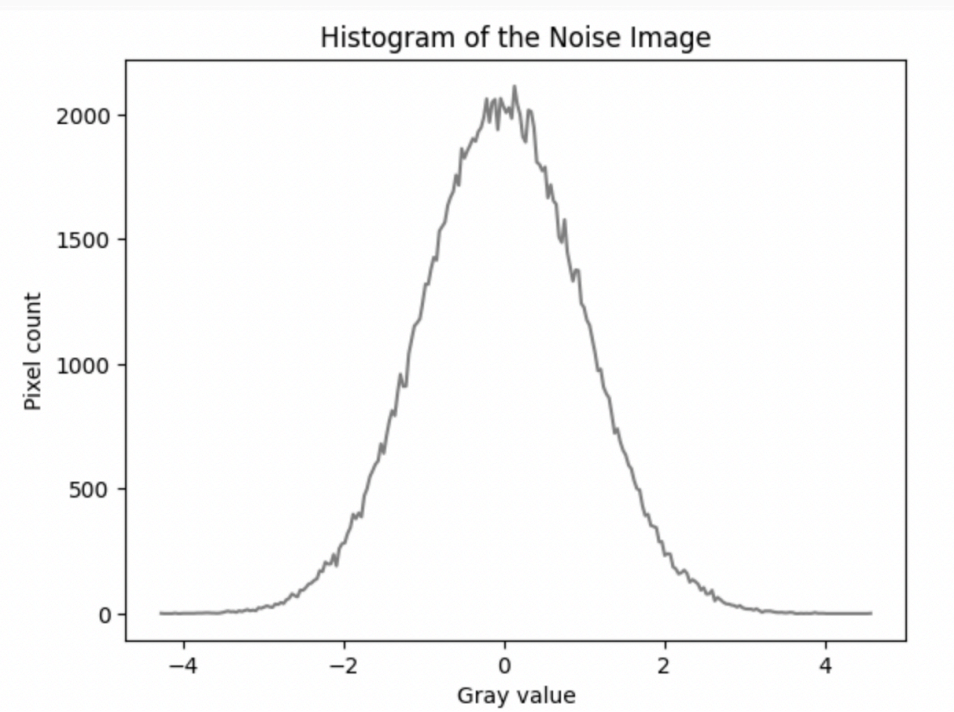

```
Minimum Grayscale Level: 0
Maximum Grayscale Level: 251
```

5. Generate a gaussian white noise image with the same dimensions. Define clearly the parameters (means, standard deviation or variance) in this generation.

Ex:
Parameters of GWN:
Mean = 0
Variance = 1
Standard_deviated = 1

6. Display the histogram of the noise image. Check the distribution and compute its characteristics (mean and standard deviation / variance). Compare with the parameters of the noise generator.

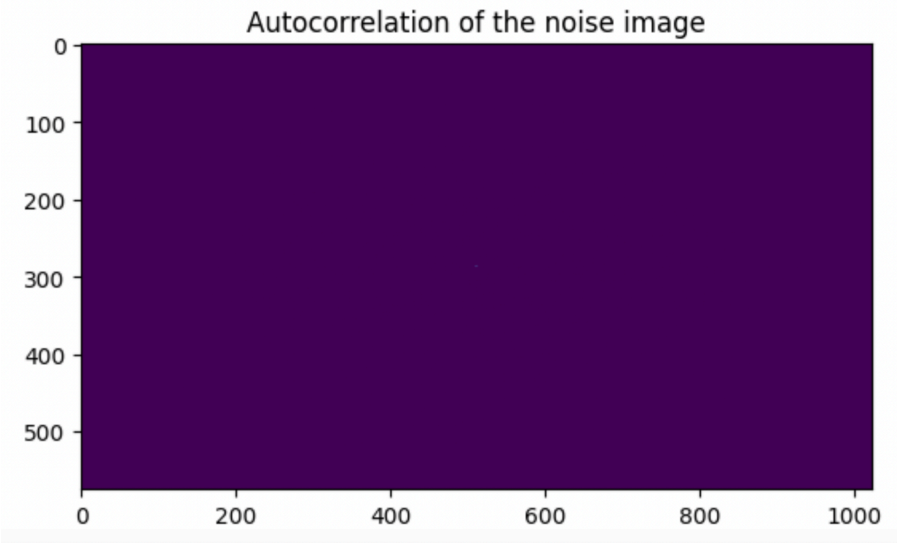
Histogram of the generated a Gaussian Noise:




```
noisy mean: 0.00
noisy variance and std: 1.00   1.00

Expected mean: 0
Expected variance and std: 1.00   1.00
```

7. Compute the autocorrelation of the noise image. Deduced the theoretical result.



8. Compute the SNR (signal-to-noise ratio) here defined as :

Using the formula:
`SNR = (max_image - min_image) / std_noise`
to compute the Signal-to-Noise Ratio.

Also, calculate SNR in decibels using the formula:
`SNR_dB = 20log10((max_image - min_image)/std_noise)`

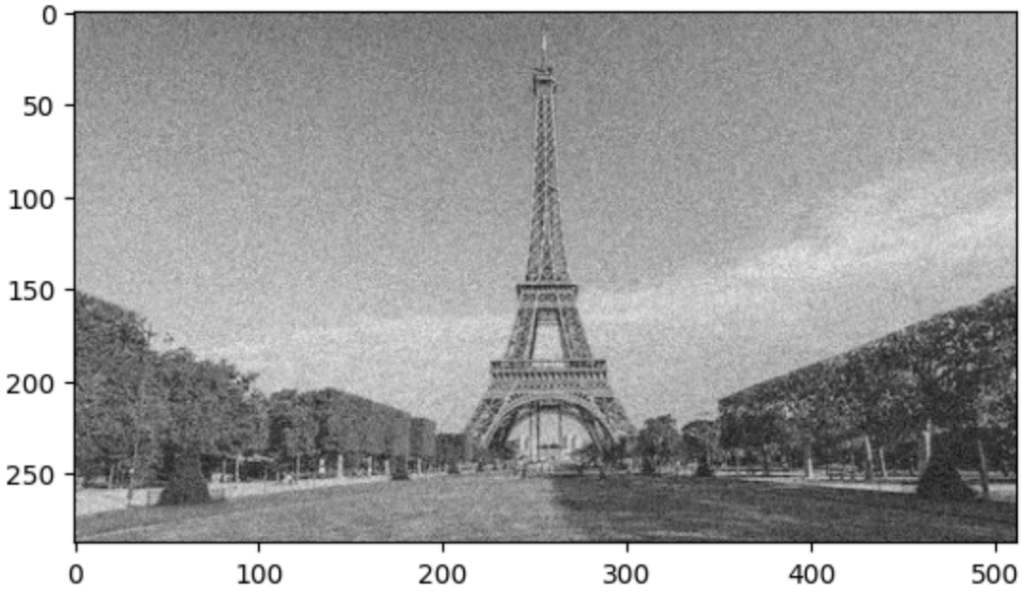
SNR: 251.52
SNR (dB): 48.01

9. Add the noise to the information image leading to a noisy image. Check the histogram of the noisy image.

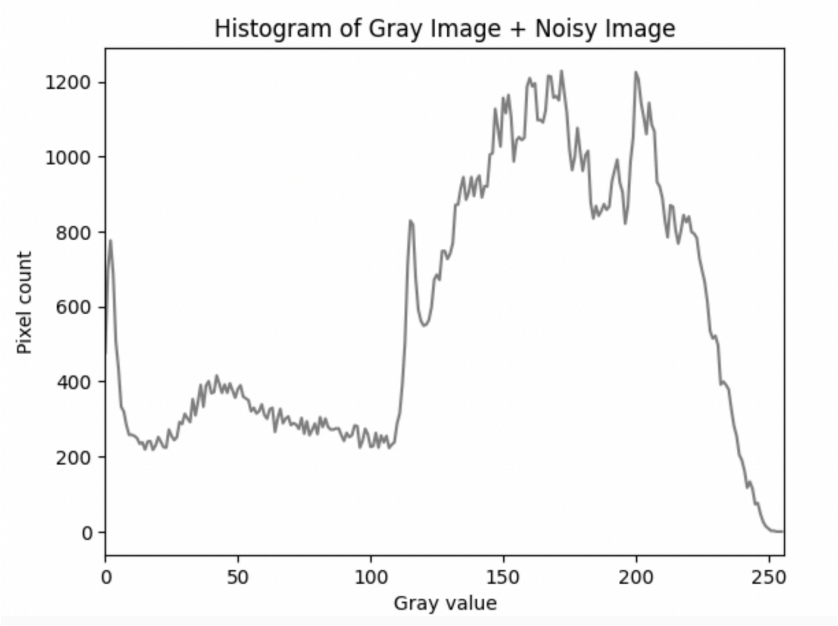
Noise Generation and Analysis:

Generate Gaussian White Noise and Display the noise image and its histogram.

GrayScale + White Noise Image:



Analyze the distribution of the noise image and compute its characteristics, including mean and standard deviation/variance.


Histogram of Gray Image + Noisy Image
Pixel count
Gray value
0
200
400
600
800
1000
1200
0
50
100
150
200
250


Histogram of the gray image
Pixel count
Gray value
0
250
500
750
1000
1250
1500
0
50
100
150
200
250

10. Apply a smoothing filter h of your choice and compute the new SNR (it is simpler to apply h on the noisy image and the information image separately).