

COMPUTER VISION

LECTURE 5

ASSIGNMENT

Introduction:

Noise in image is a random variation in pixel values which does not represent the true content of the image. It is generally an unwanted thing that stays in an image and can degrade the quality of an image.

Goal:

The main goals of this assignment are to understand different types of noises in images caused by various reasons such as motion, light, focus, understand statistical variables like mean and variance, implement different types of mean denoising and image sharpening with different types of mean.

In this assignment we are working with 5 different types of noises which are:

1. Gaussian noise
2. Salt and Pepper noise
3. Poisson noise
4. Color noise

Original Images



Original Images



Original Images



1. Gaussian noise

The gaussian noise occurs in an image due to electronic circuit noise and sensor noise due to poor illumination and high temperature.

Mean= 1.2 Variance=1

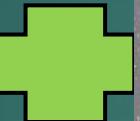
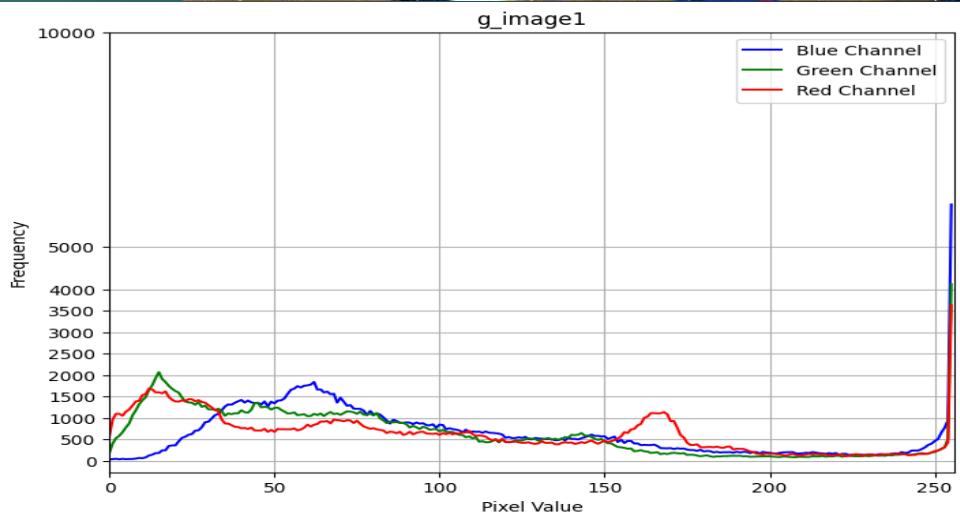
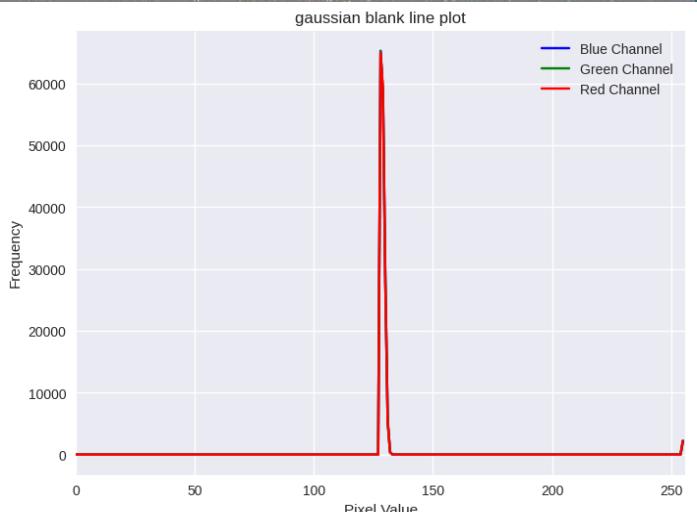
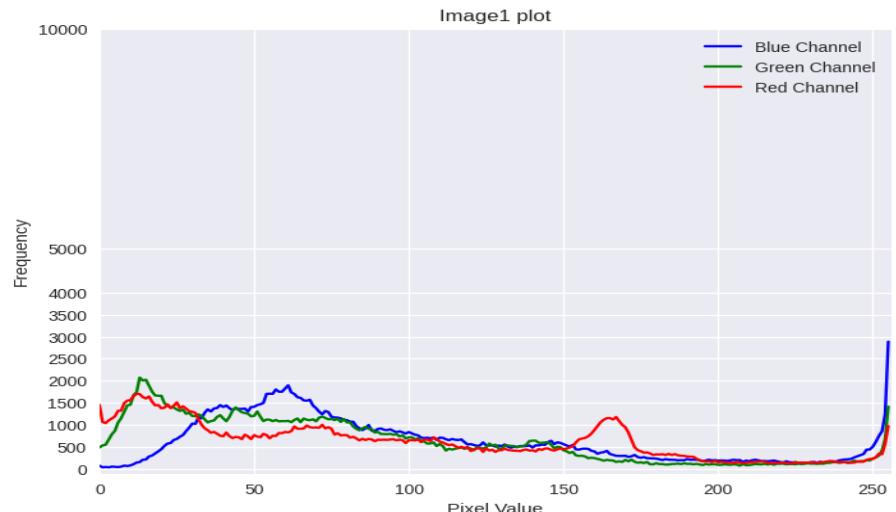


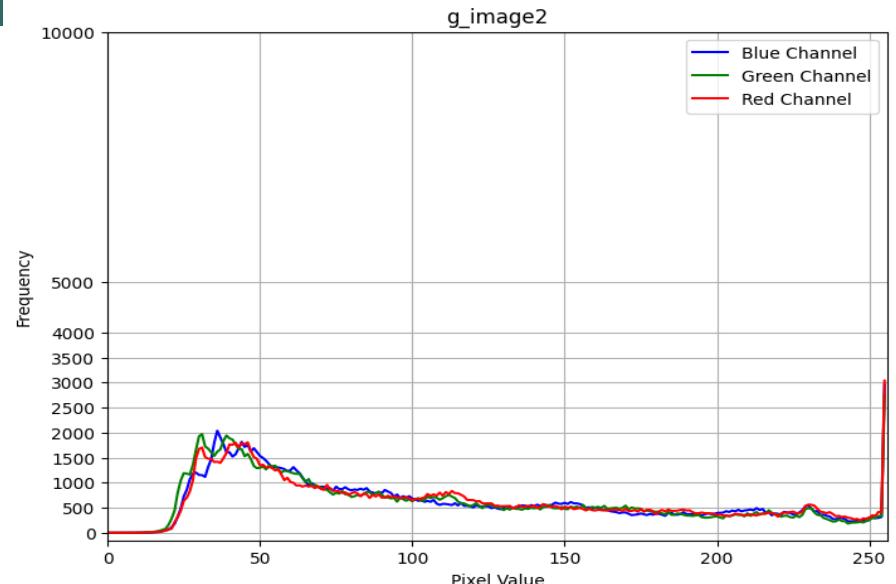
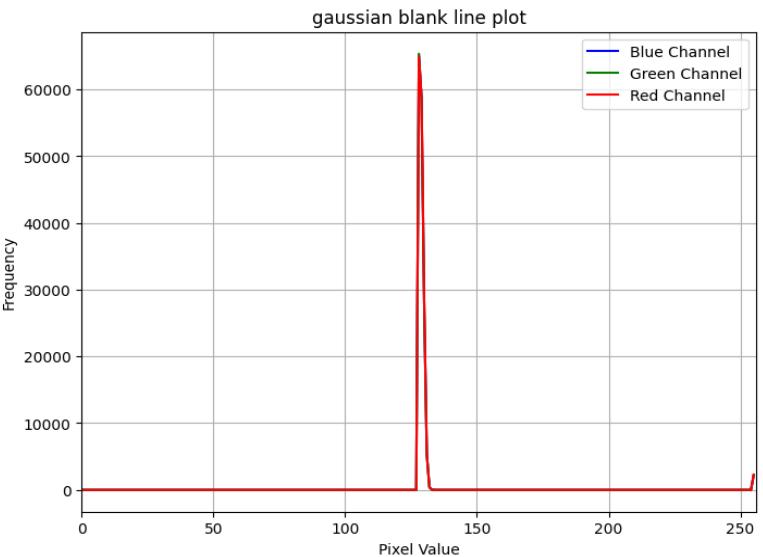
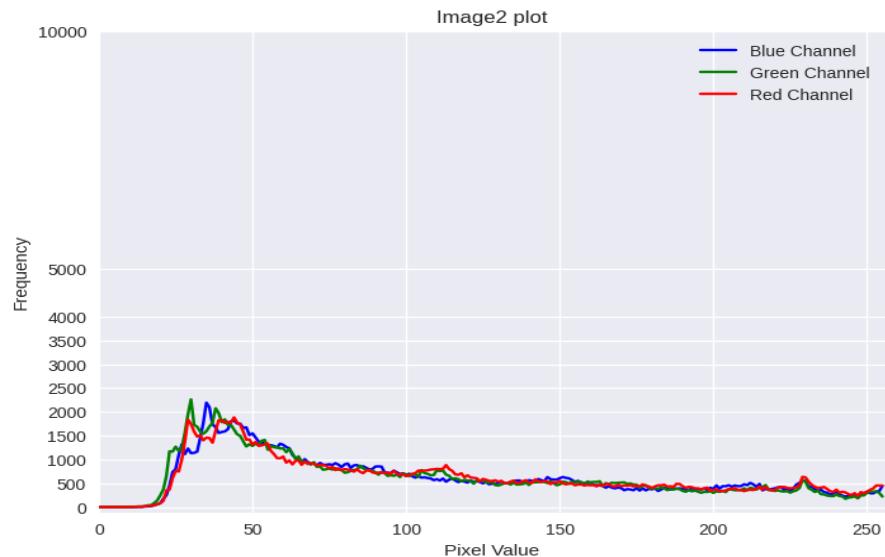
Image1 Non-Violent



Gaussian noise



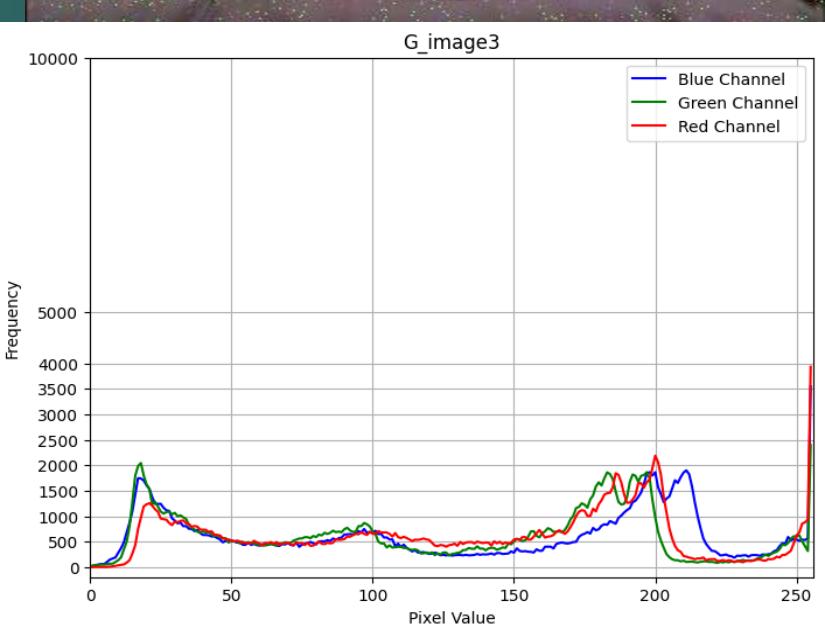
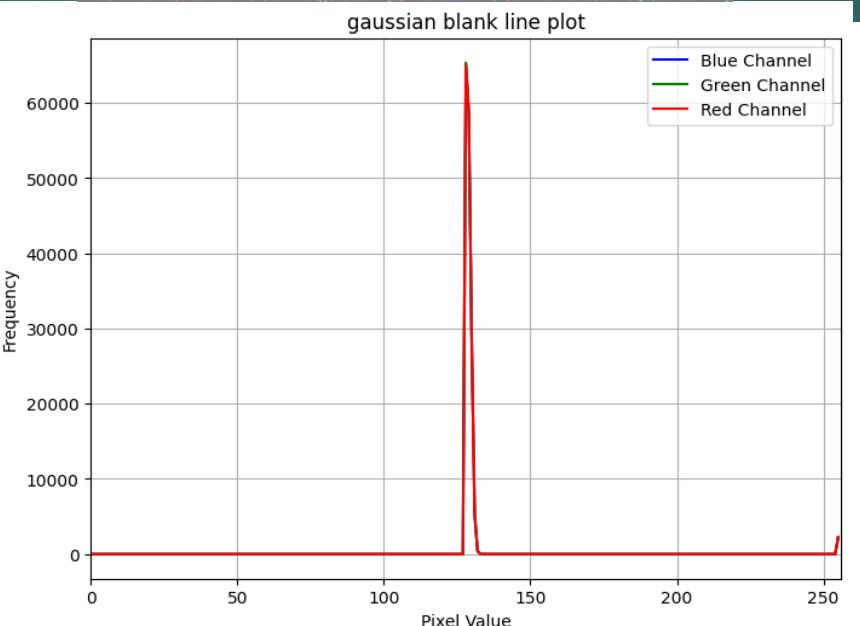
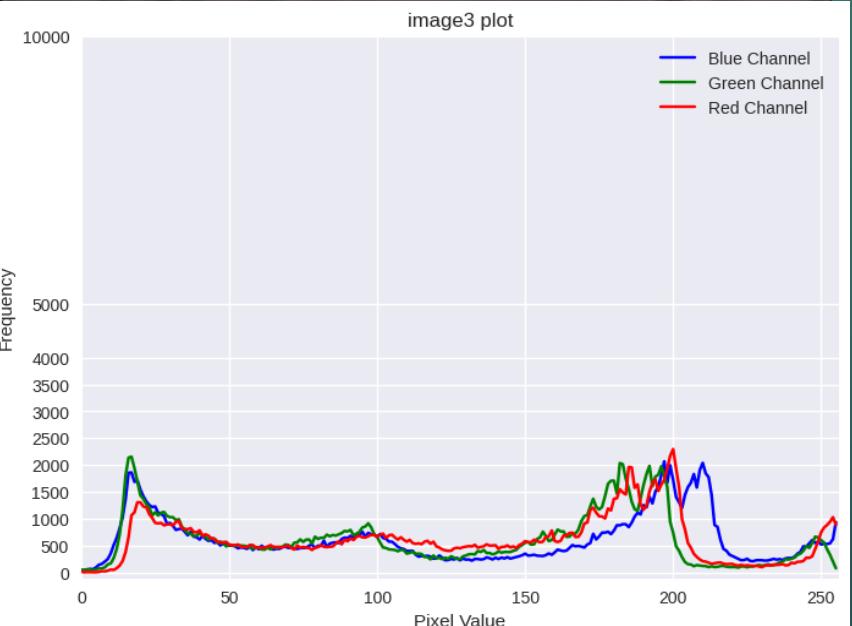
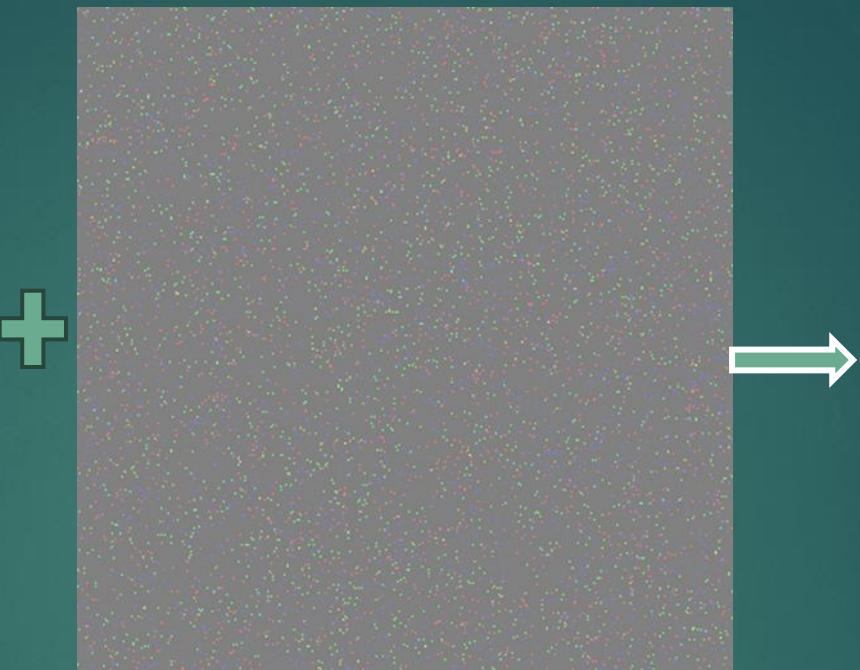
Image 2 Violent



Gaussian



Image 3 Violent



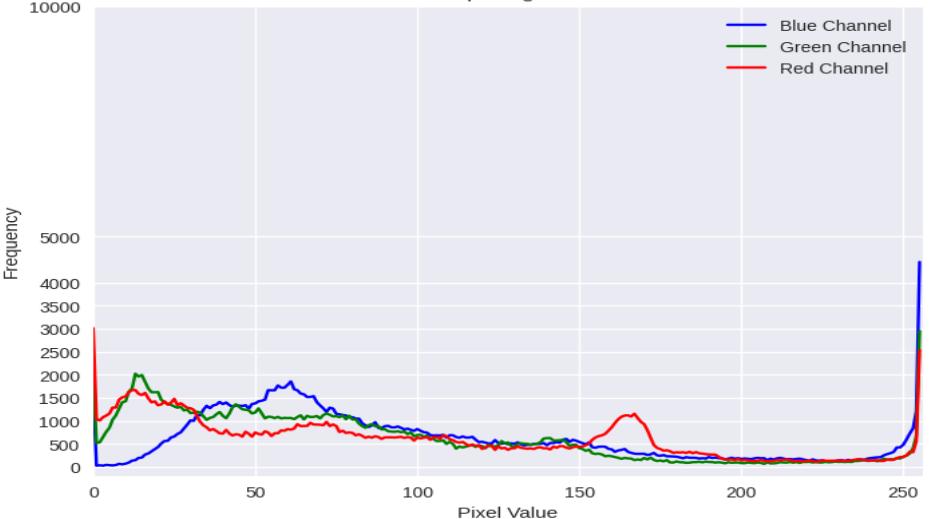
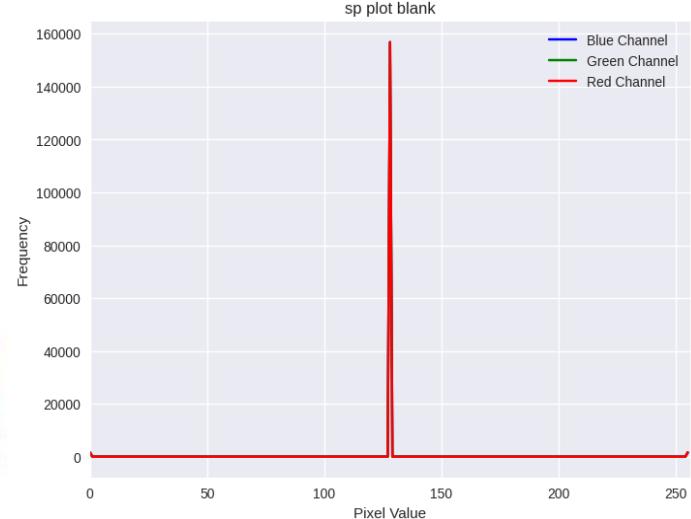
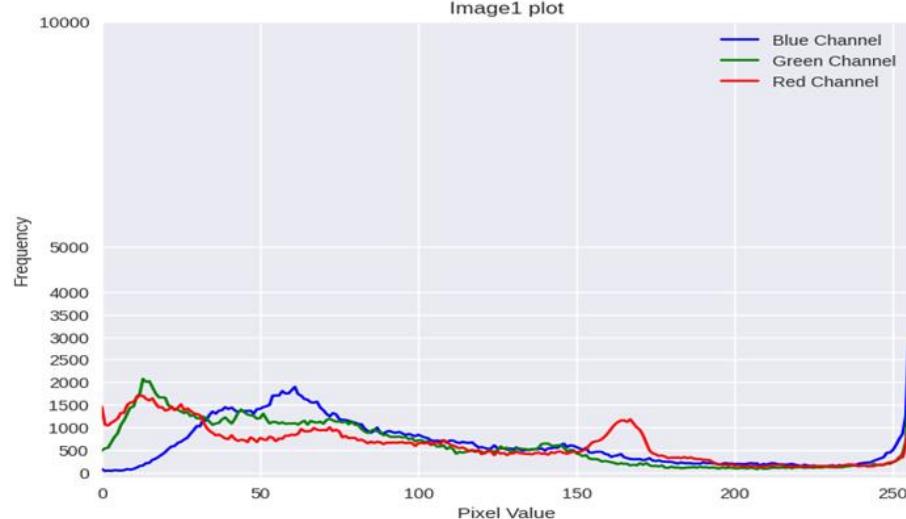
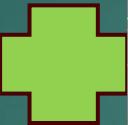
2.Salt and Pepper Noise

Image1 Non-Violent

This noise occurs because of distortion characterized by the appearance of random, isolated bright and dark pixels in an image or random spikes in a signal. It can also occur during printing because of dust or dirt.

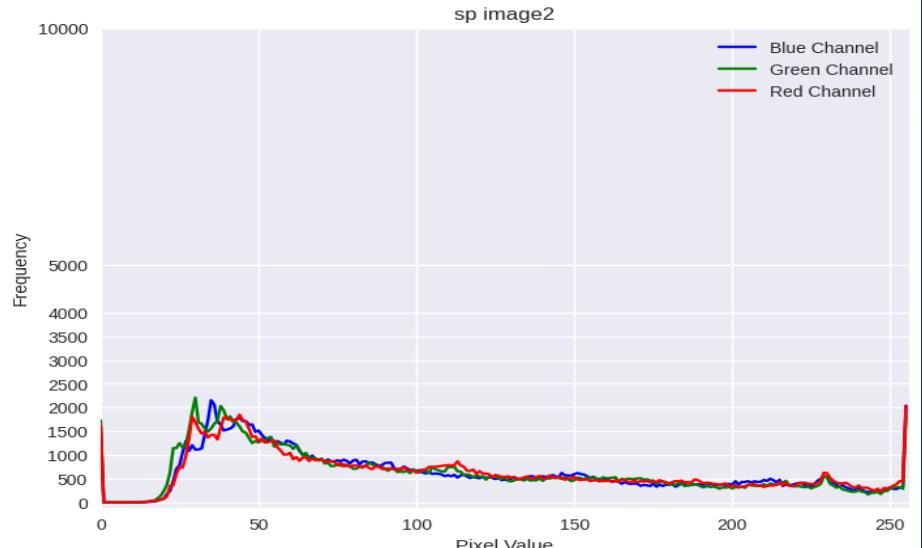
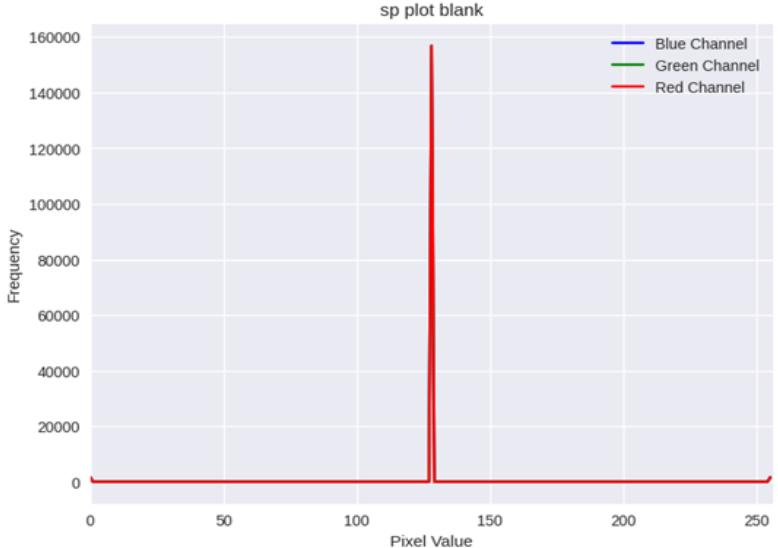
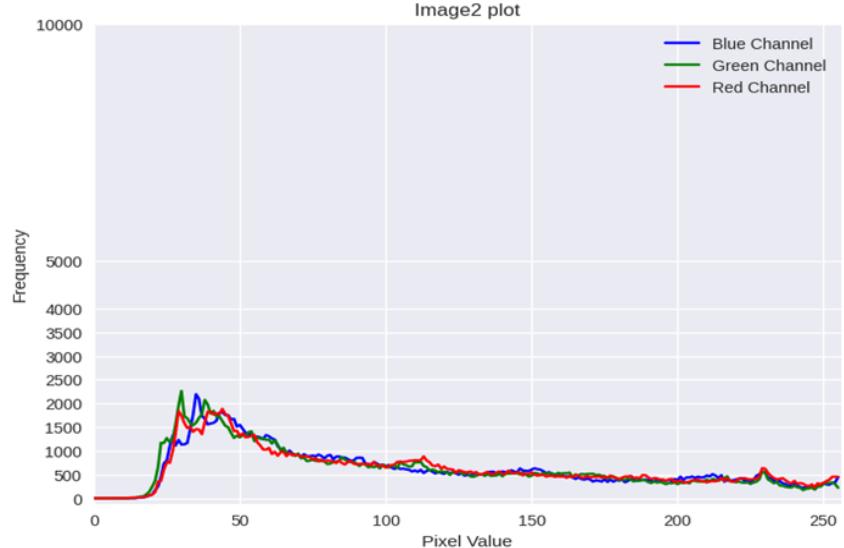
Salt value = 0.01

Pepper value= 0.01



Salt and Pepper

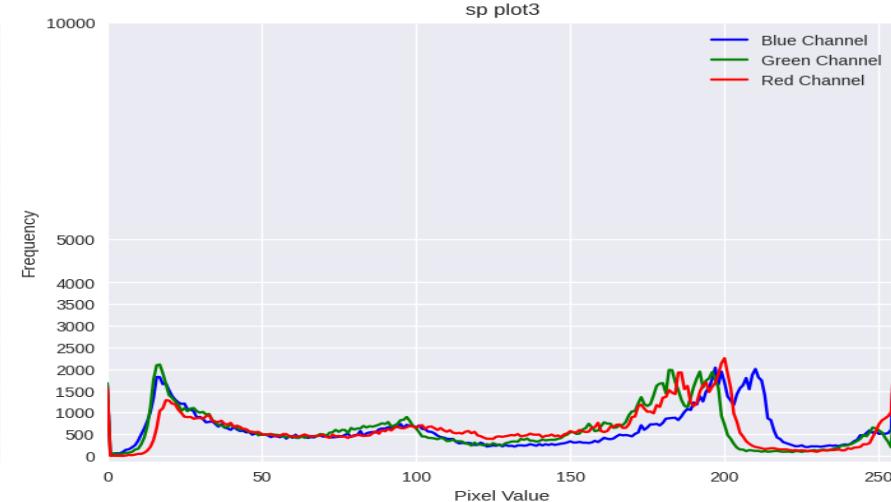
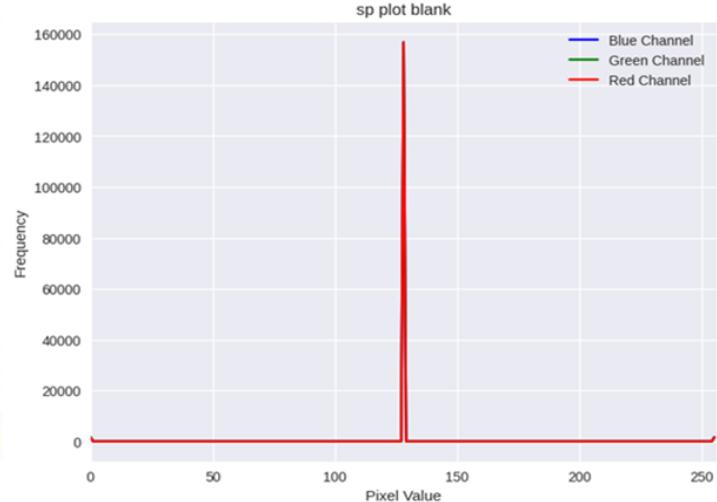
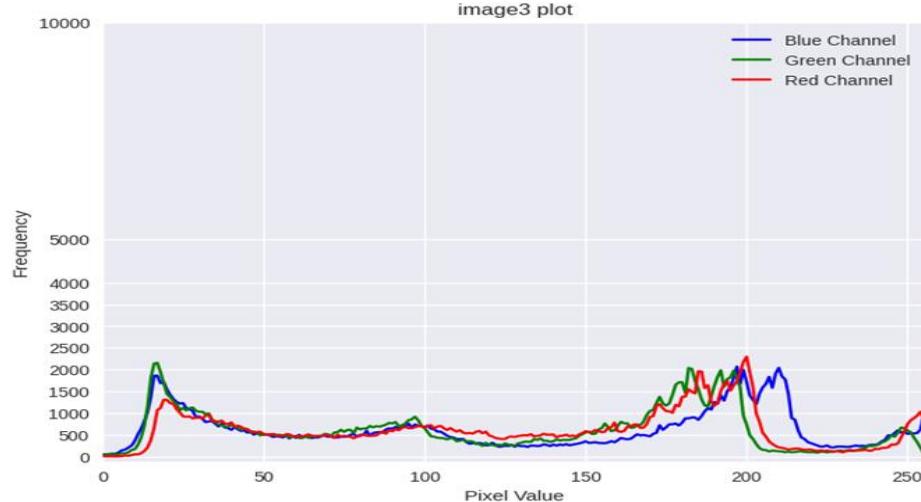
Image 2 Violent



Salt and Pepper



Image 3 Violent



3.Poisson Noise

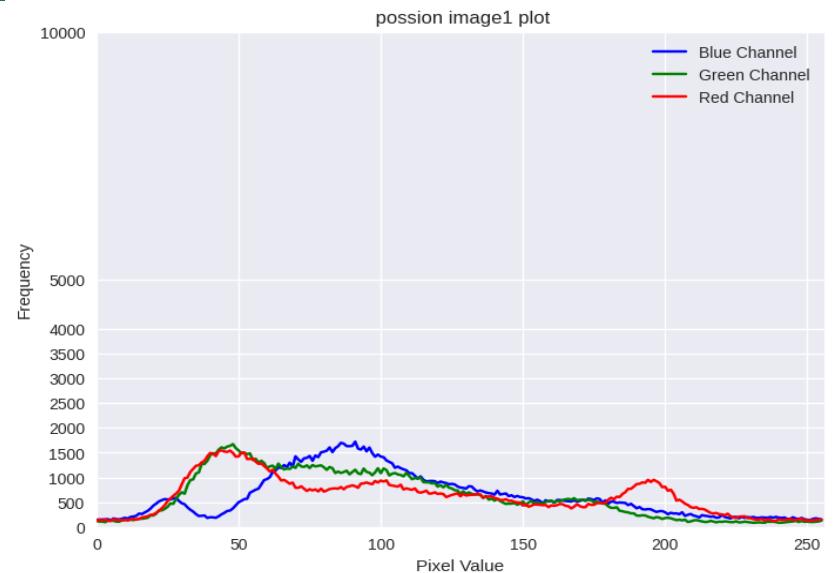
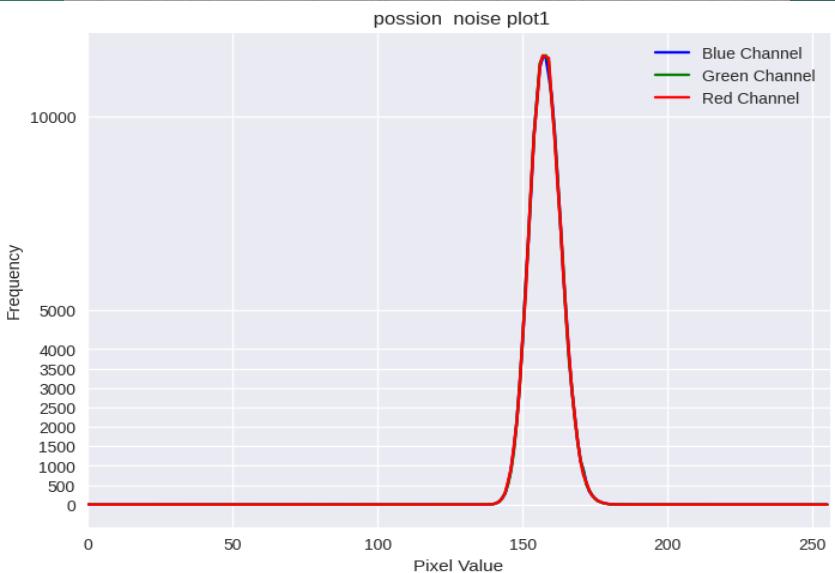
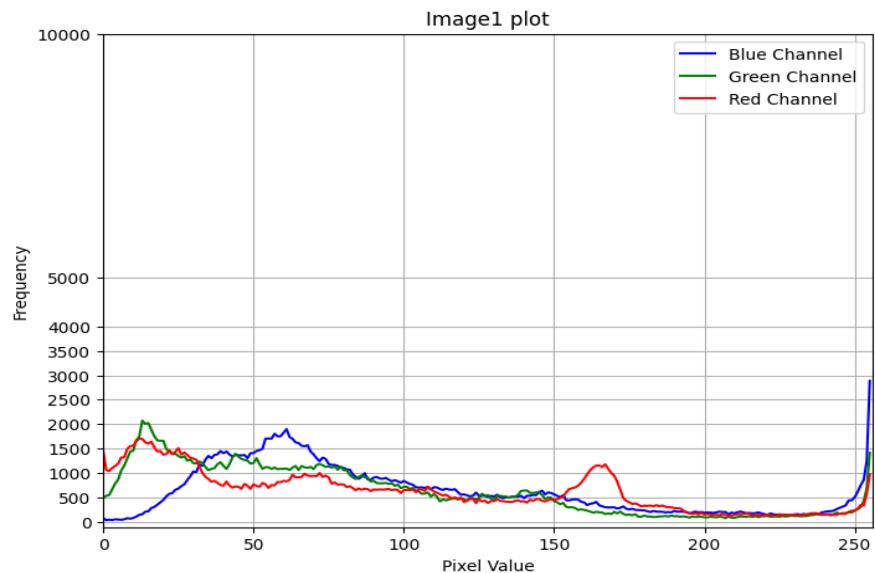
Poisson noise in images typically appears as grainy or

speckled patterns and can affect the visual quality of the image.

Image 1 Non-Violent

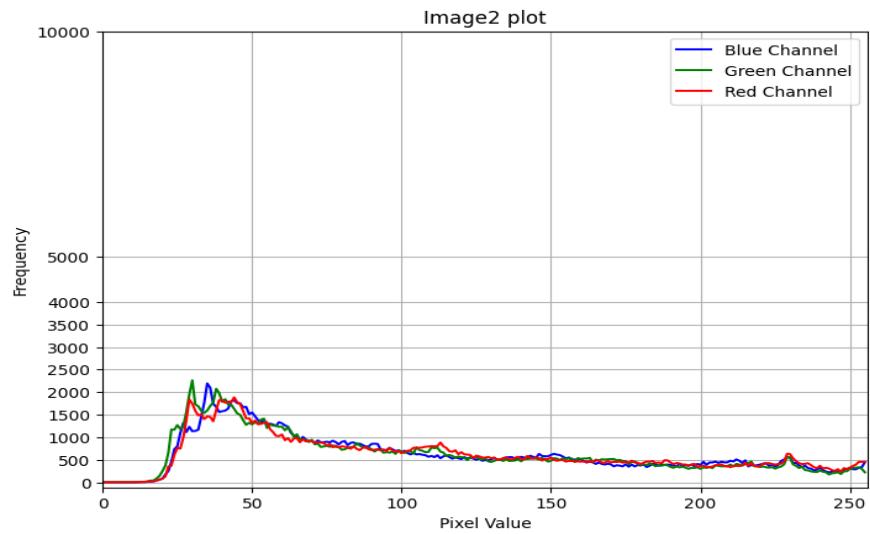


Intensity=30



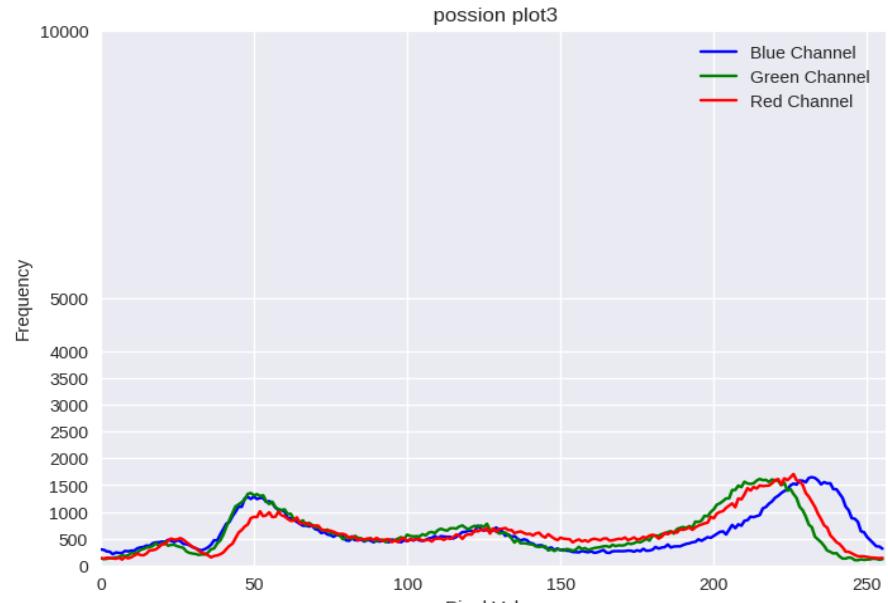
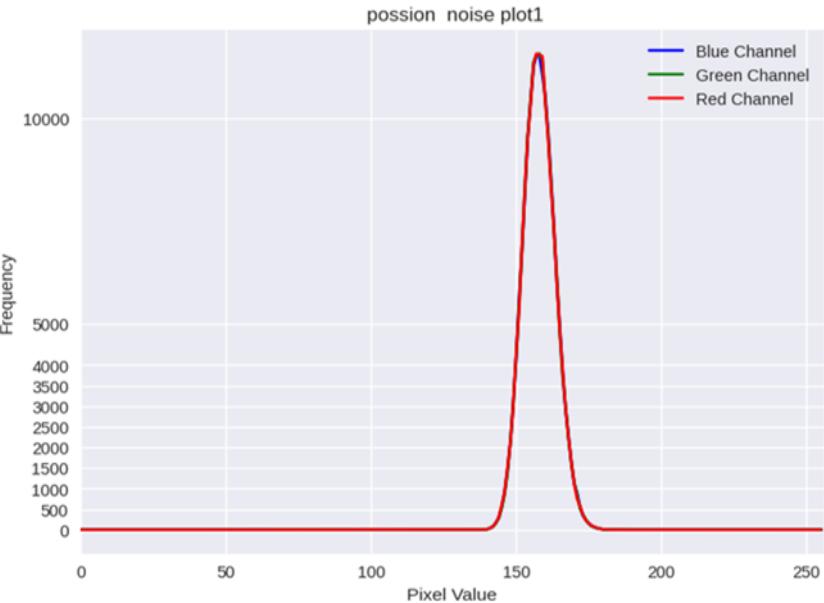
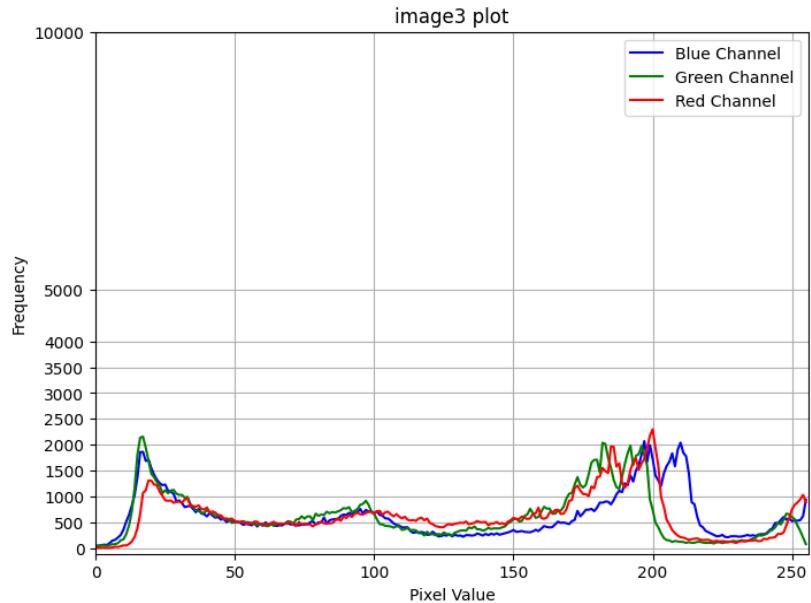
Poisson

Image2 Violent



Poisson

Image3 Violent

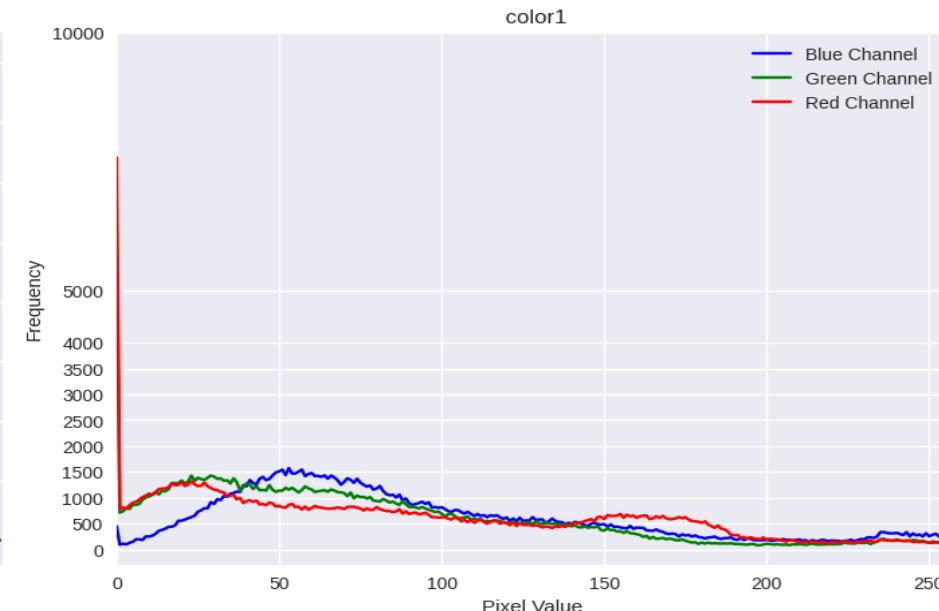
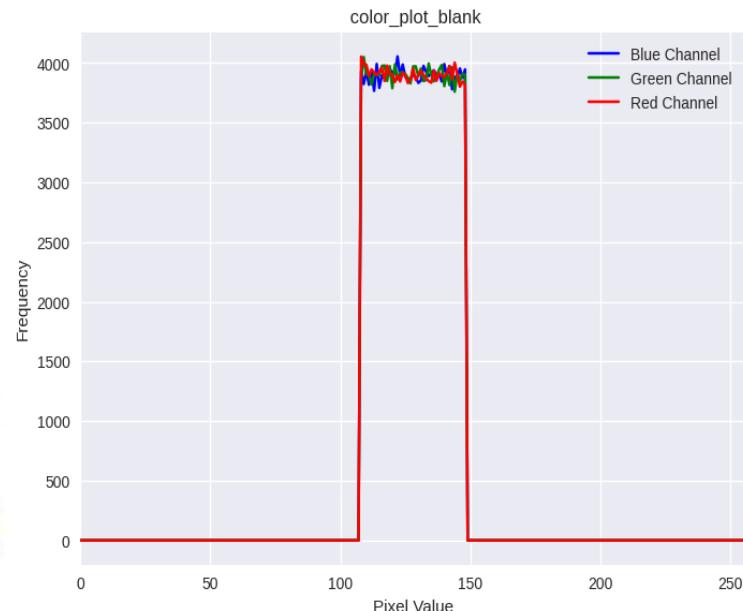
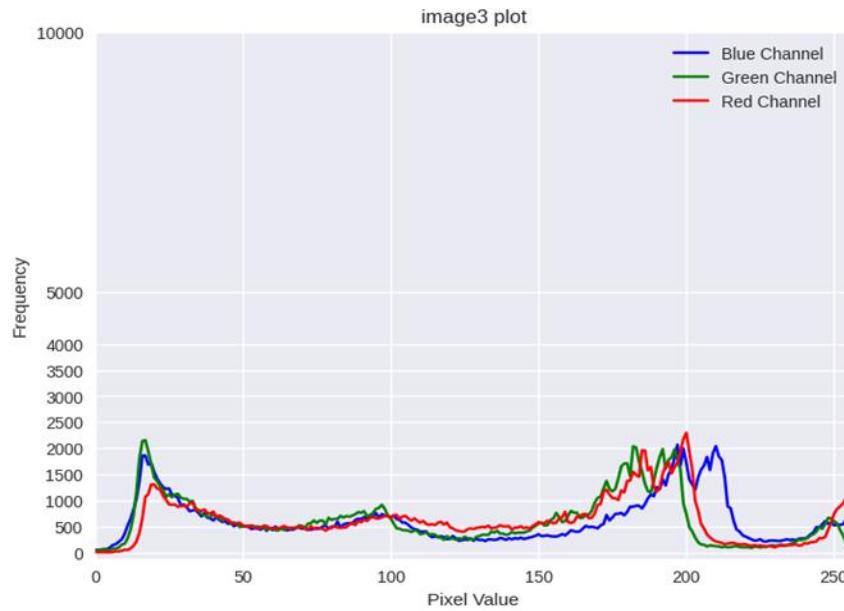


Color Noise

It is an unwanted variation in color.

Image 1 Non-Violent

Noise level =20

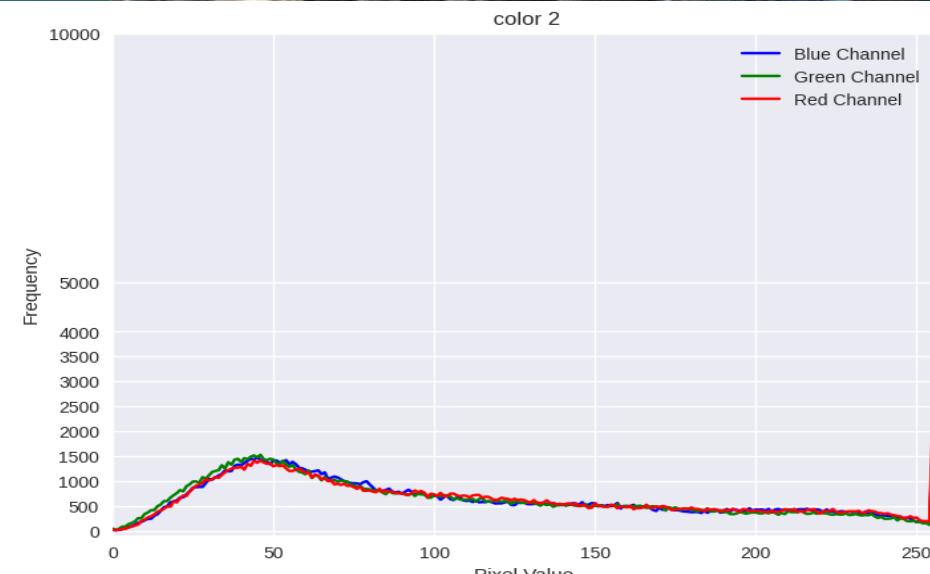
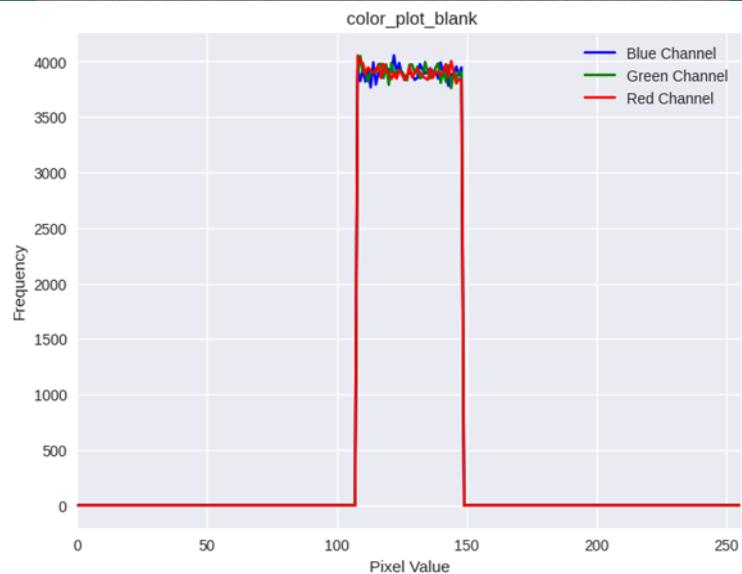
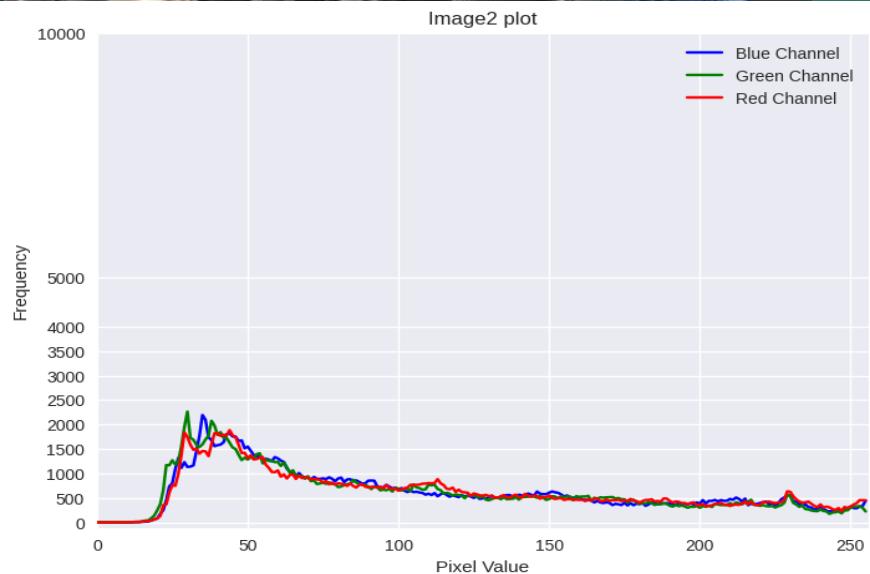


Color Noise

Image 2 Violent

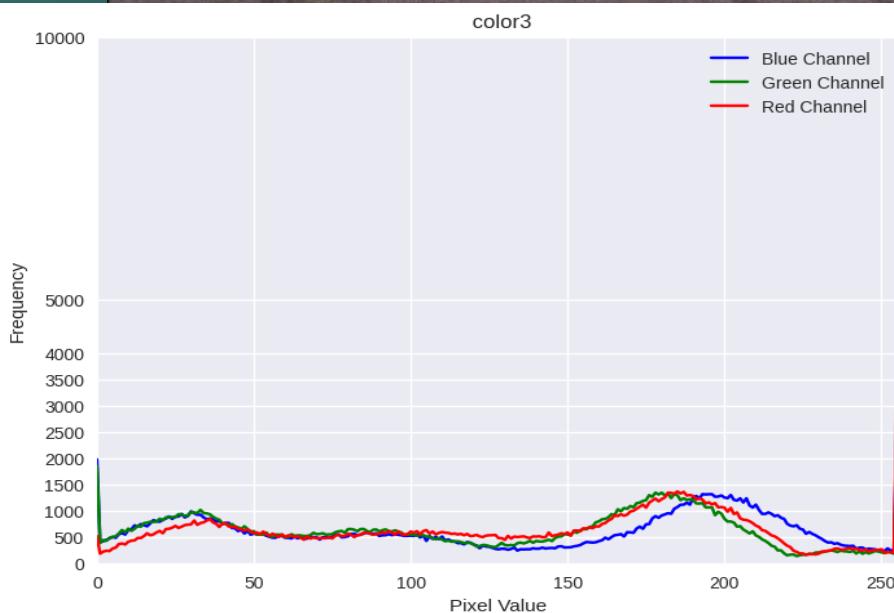
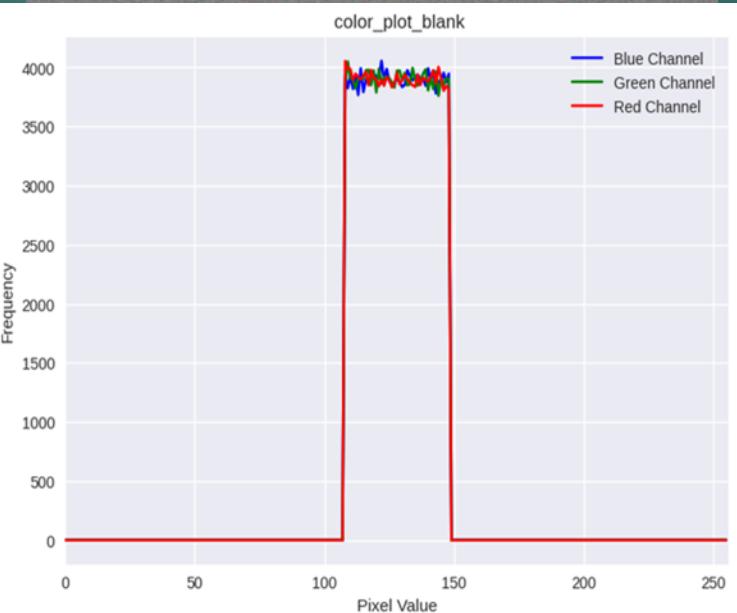
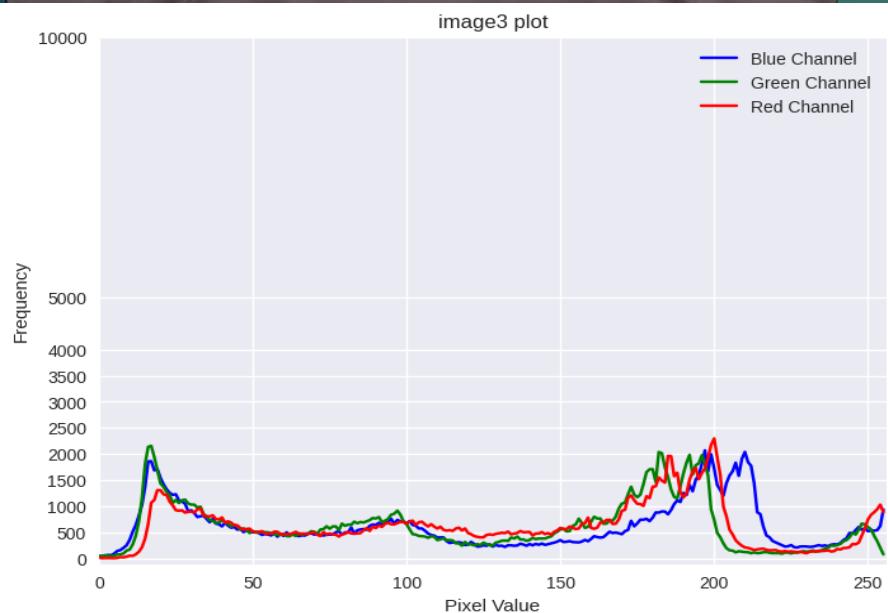


+



Color Noise

Image 3 Violent



2. Estimate noise parameters from a single image

Original image



Gaussian Noise Image

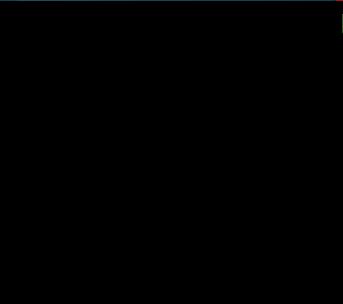


Point of Interest x, y, width, height =[200,17,25,25]

Original POI



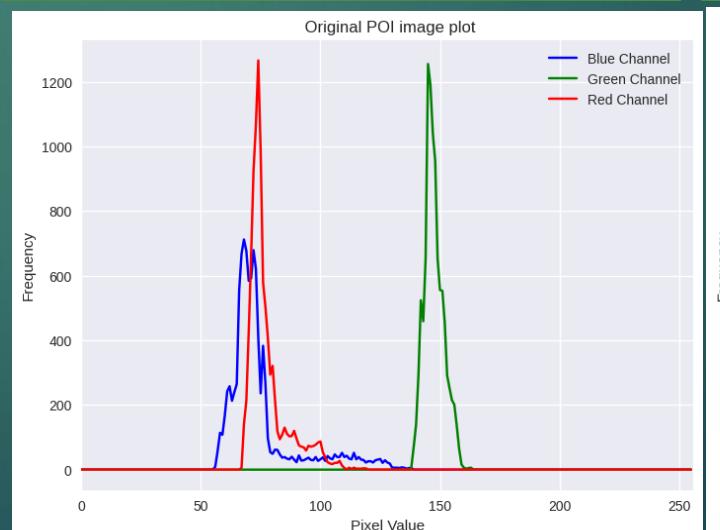
POI after Noise



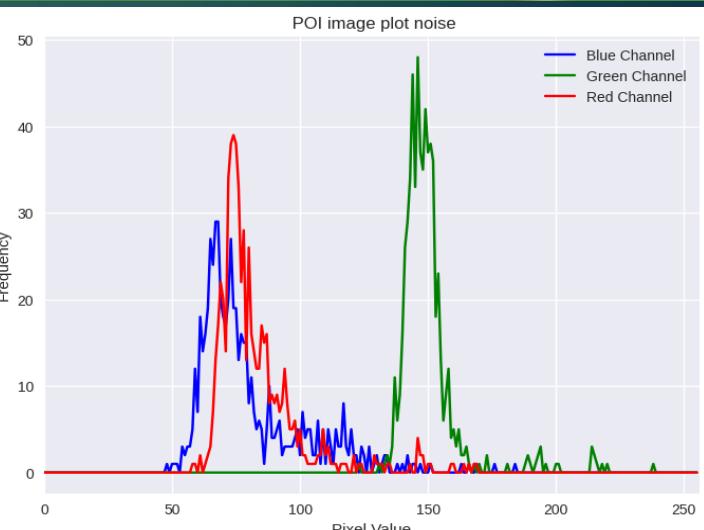
Zoom in Images for POI

Mean=87.76
Variance=4095.84

Formula for mean and variance
 $\text{mean} = \text{np.mean(POI)}$
 $\text{variance} = \text{np.var(POI)}$



Mean=100.15, variance=1226.51



Mean=104.37 variance=1326.2

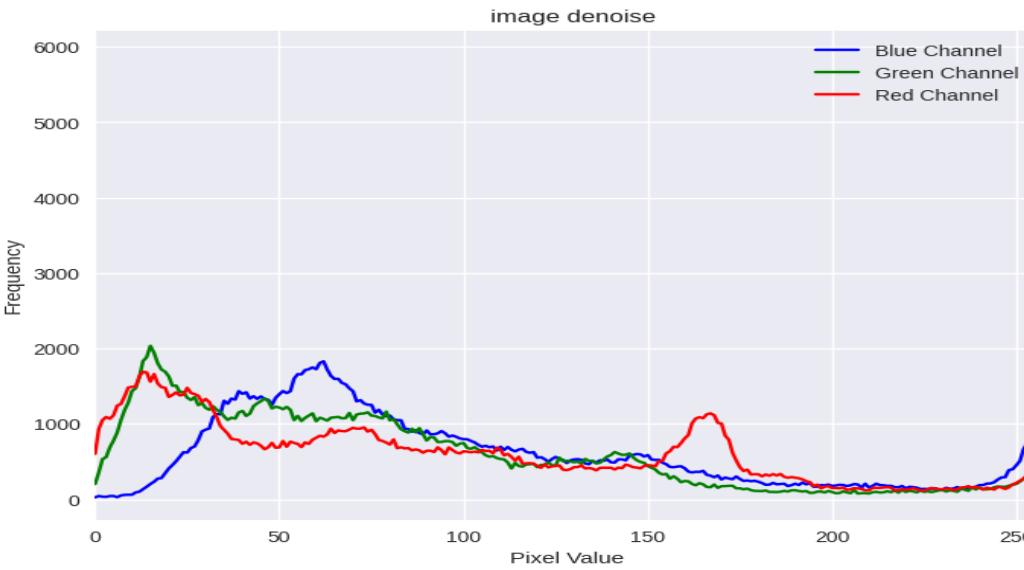
Apply a class of Mean filter

Gaussian noise image

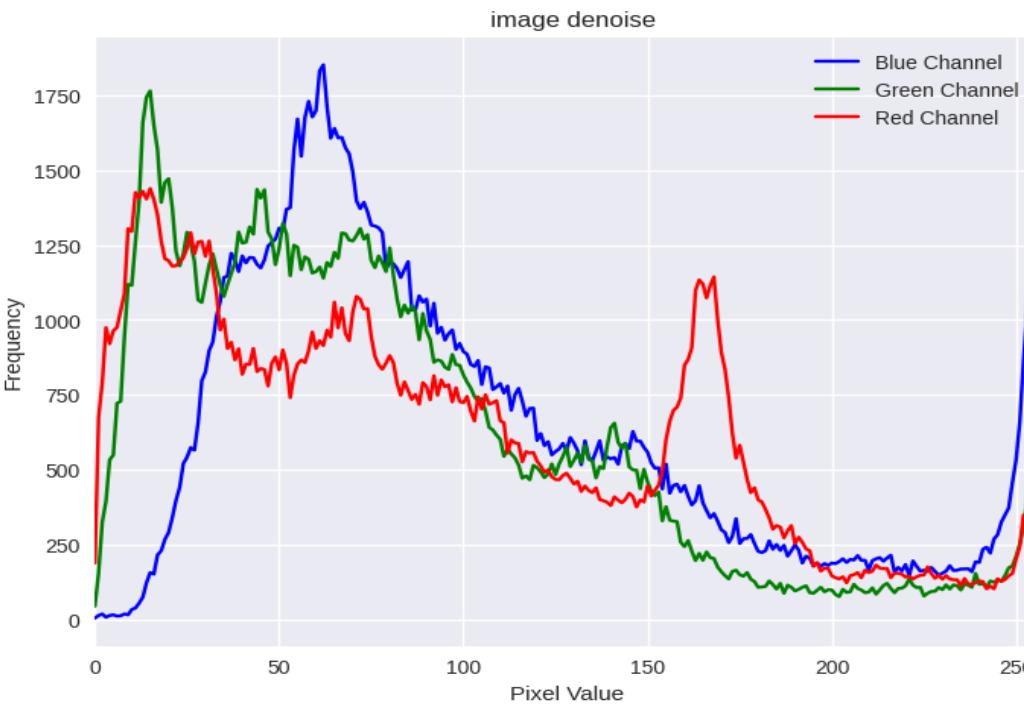


1. Arithmetic Mean

Arithmetic Mean = 12



Arithmetic mean denoising



Noised image statistics

Mean: 90.88

Variance: 4411.78

Median=76.0

Denoised image statistics

Mean: 90.43

Variance: 3779.61

median 76.0

Kernel size=(3,3)

.

neighborhood

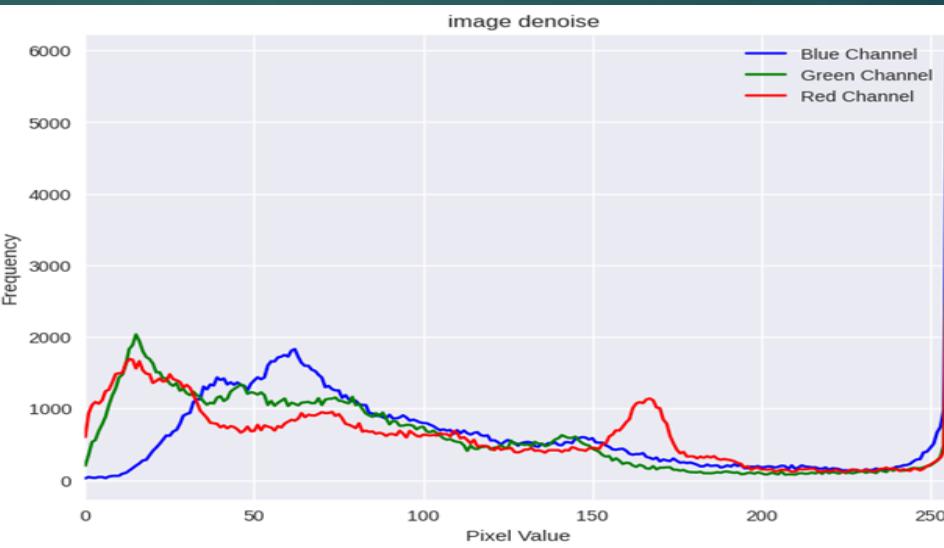
```
[[10, 11, 16]
 [11, 11, 17]
 [ 9, 10, 13]]
```

2. Weighted Mean denoising

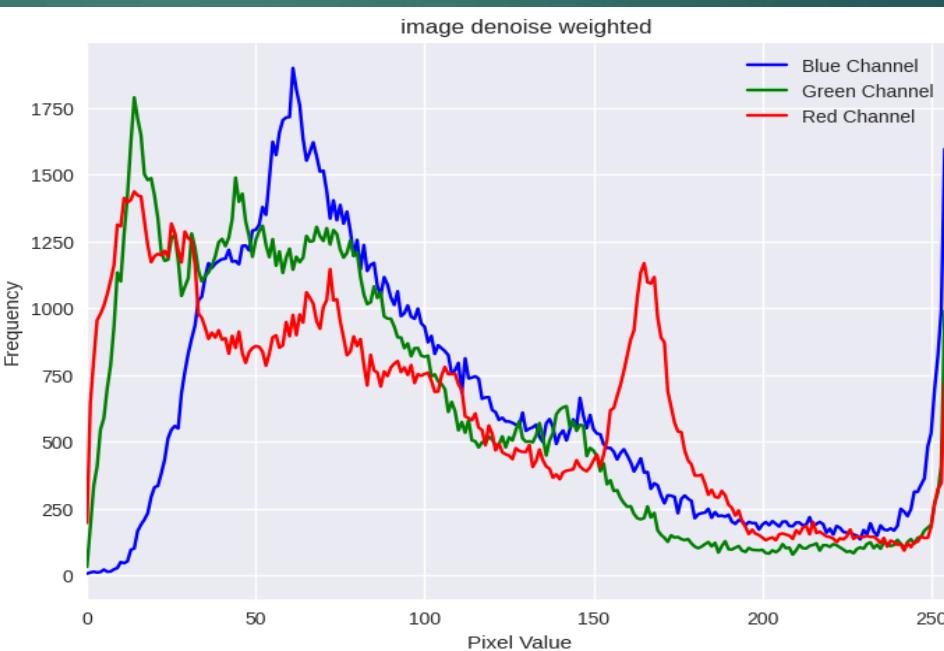
Noised Image



Weighted Mean value = 5.77



Denoised image



Noised image statistics

Mean: 90.88

Variance: 4411.78

Median=76.0

Denoised image statistics

Mean: 90.23

Variance: 3767.41

Median=76.0

kernel = np.array([[1, 1, 1],
[1, 1, 1],
[1, 1, 1]])

Neighborhood

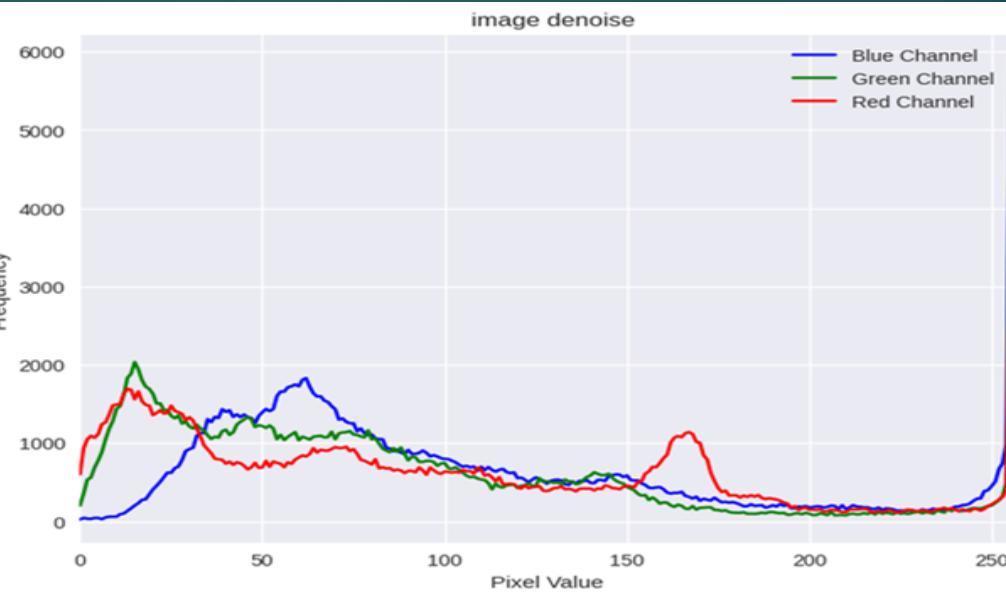
[[12, 16, 0]

[10, 14, 0]

[0, 0, 0]]

3.Geometric Mean

Noised Image



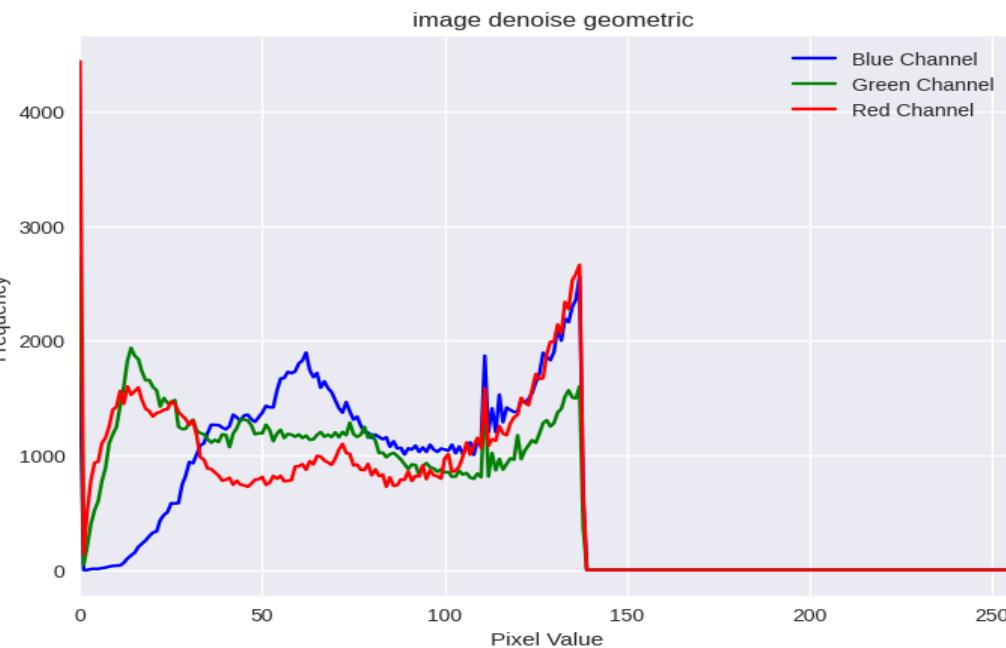
Noised image statistics

Mean: 90.88

Variance: 4411.78

Median=76.0

Denoised Image



Denoised Statistics

Mean: 73.67

Variance: 1677.66

median 72.0

Kernel=(3,3)

Neighborhood

$[12, 16, 0]$

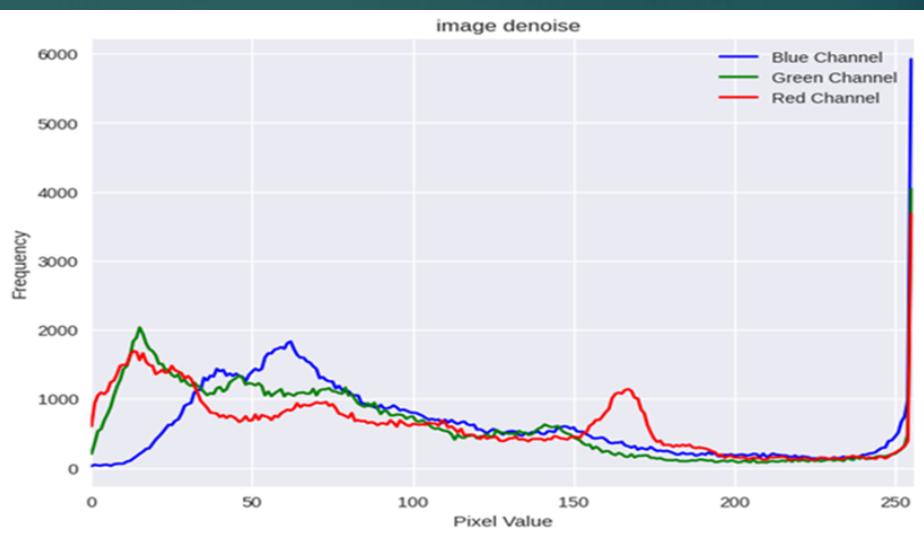
$[10, 14, 0]$

$[0, 0, 0]$

4.Harmonic Mean

Harmonic Mean=1.7999998e-06

Noised image



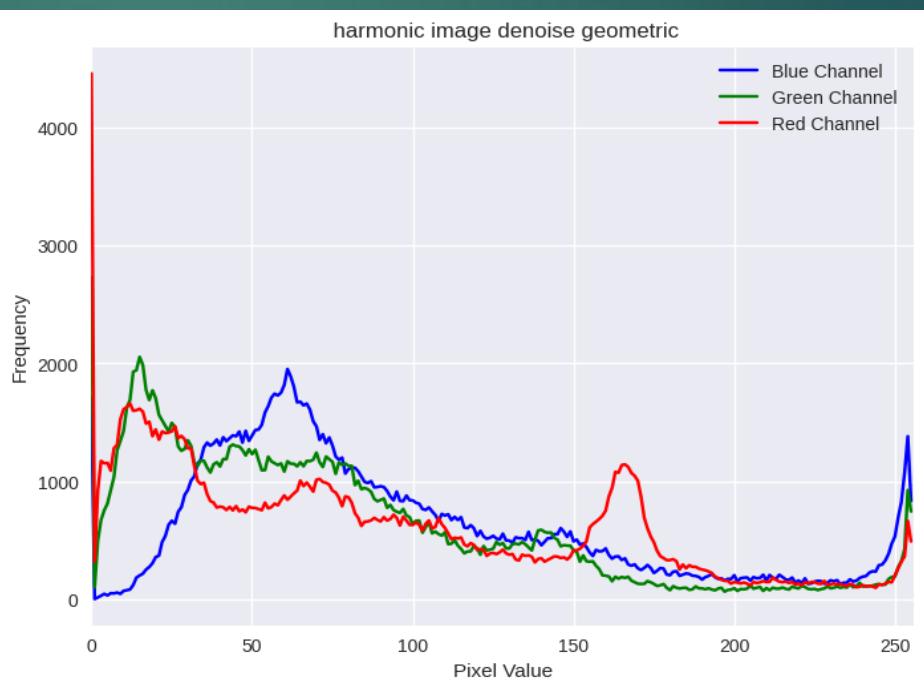
Noised image statistics

Mean: 90.88

Variance: 4411.78

Median=76.0

Harmonic mean filter



Denoised Statistics

Mean: 84.87

Variance: 3917.27

median 70.0

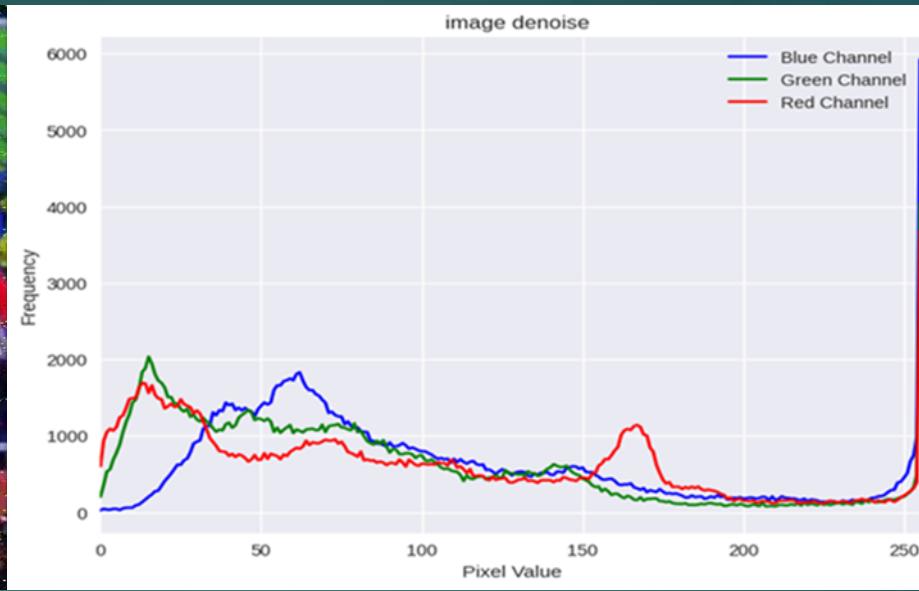
Kernel=3

Noised Image



5. Mean Filter

Mean Filter =5.8



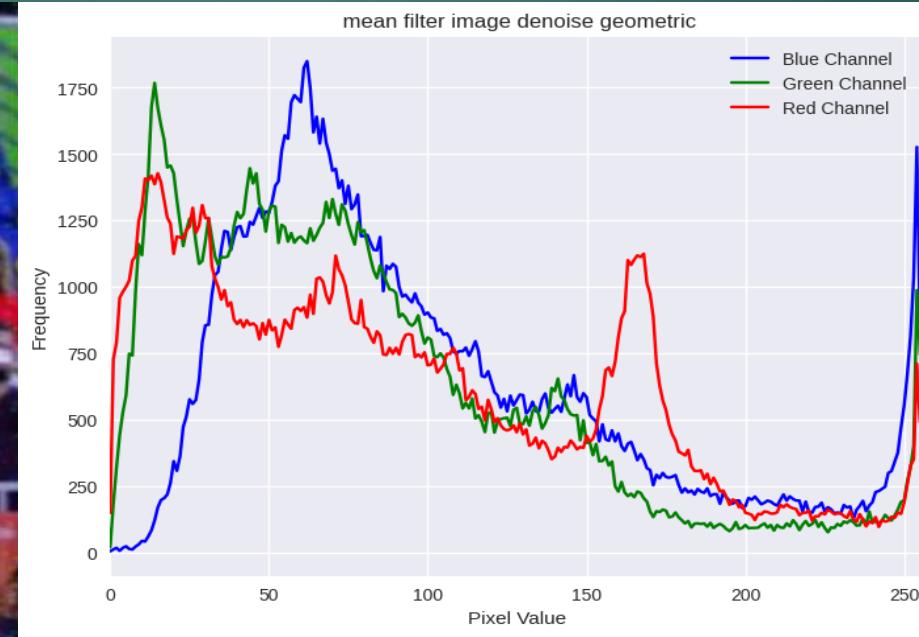
Noised image statistics

Mean: 90.88

Variance: 4411.78

Median=76.0

Mean Filter



Mean Filter statistics

Mean: 90.18

Variance: 3769.69

median 76.0

Original image



Image Sharpening

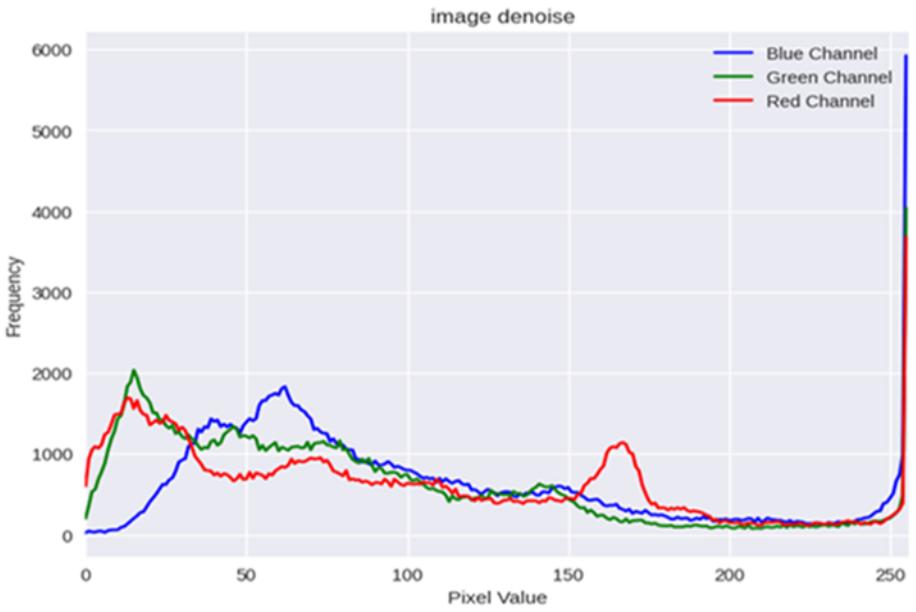
1.Arithmetic

image statistics

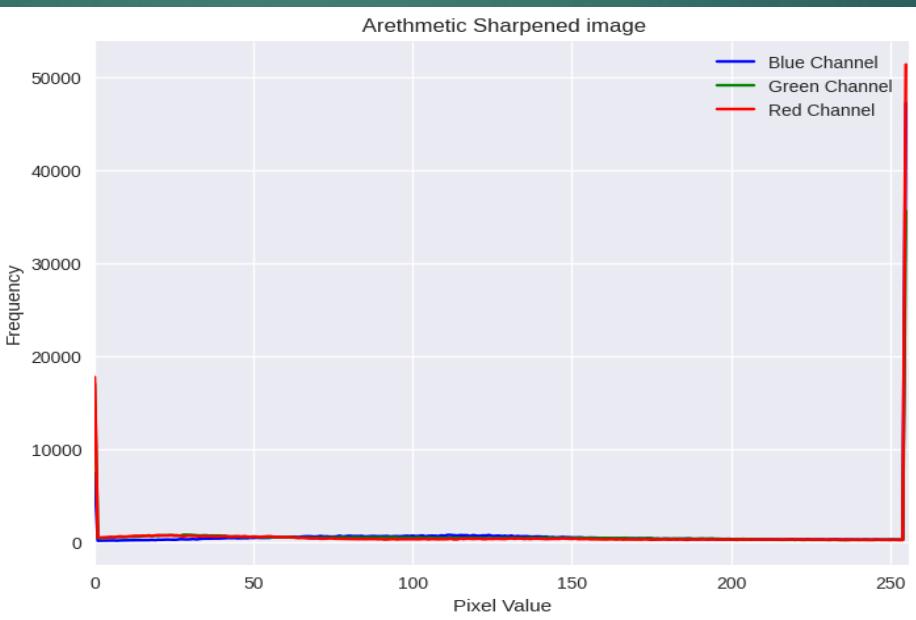
Mean: 87.76

Variance: 4095.83

Median=72.0



Sharpened Image Arithmetic



kernel = $([-1, -1, -1],$
 $[-1, 10, -1],$
 $[-1, -1, -1])$

A.Sharpened Image Statistics

Mean: 141.20

Variance: 8926.78

median 138.0

Original Image



2. Weighted Sharpening

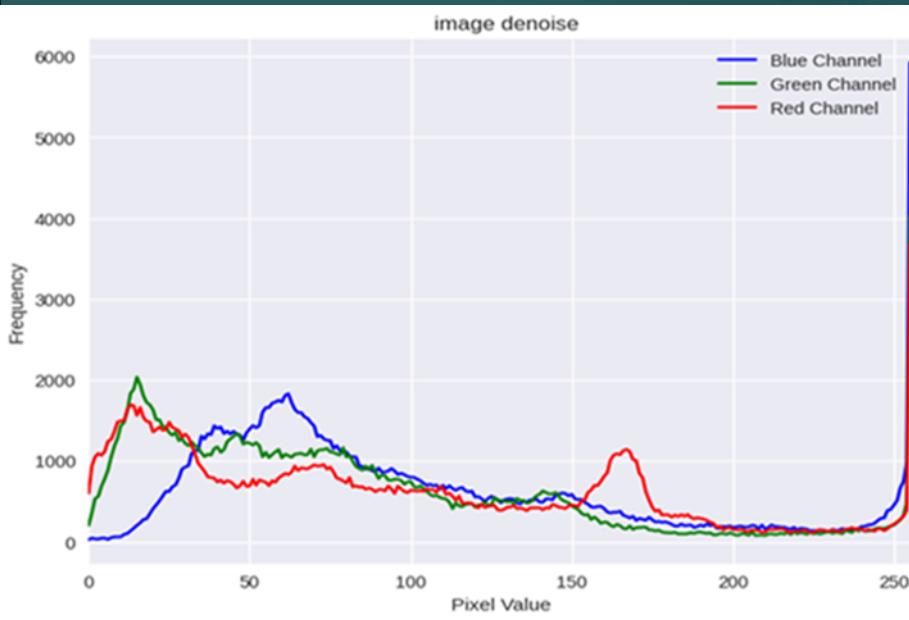
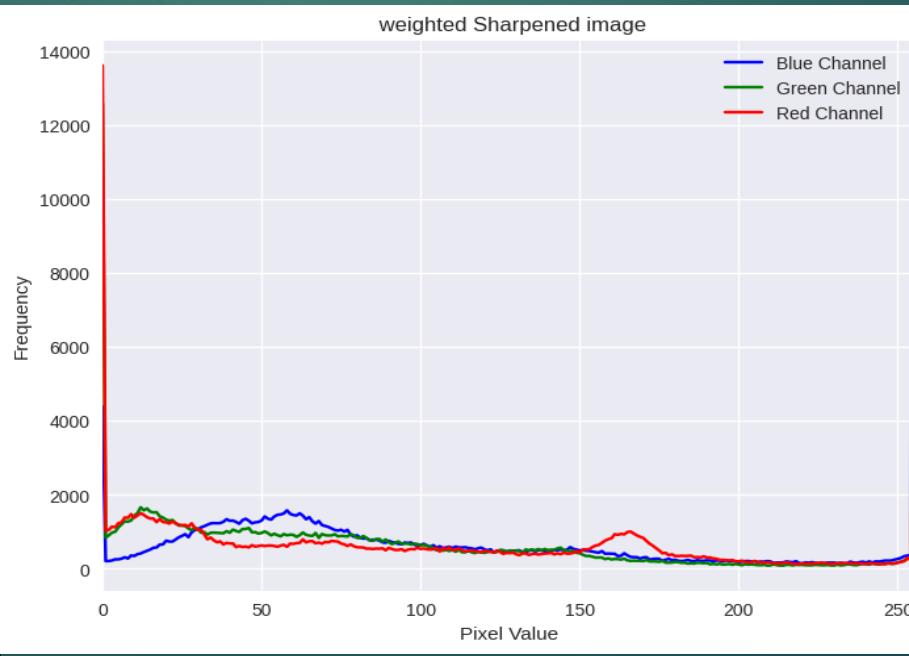


image statistics
image statistics

Mean: 87.76
Variance: 4095.83
Median=72.0

Sharpened Image Weighted



Using this
kernel = np.array([[0, -1, 0],
[-1, 5, -1],
[0, -1, 0]])

Weighted Sharpened Statics
Mean: 87.65
Variance: 5131.01
median 70.0

3.Gheometric Sharpening

Original Image

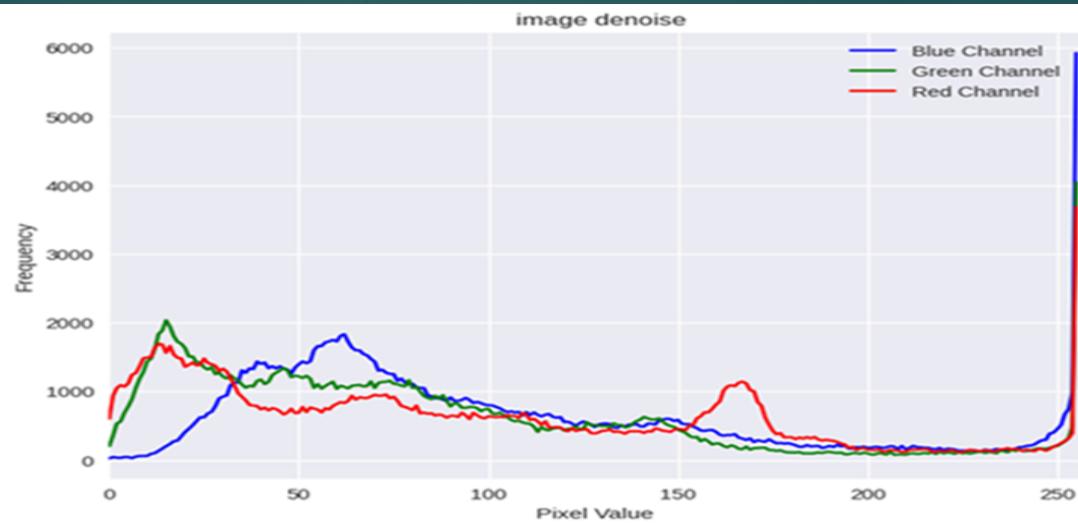
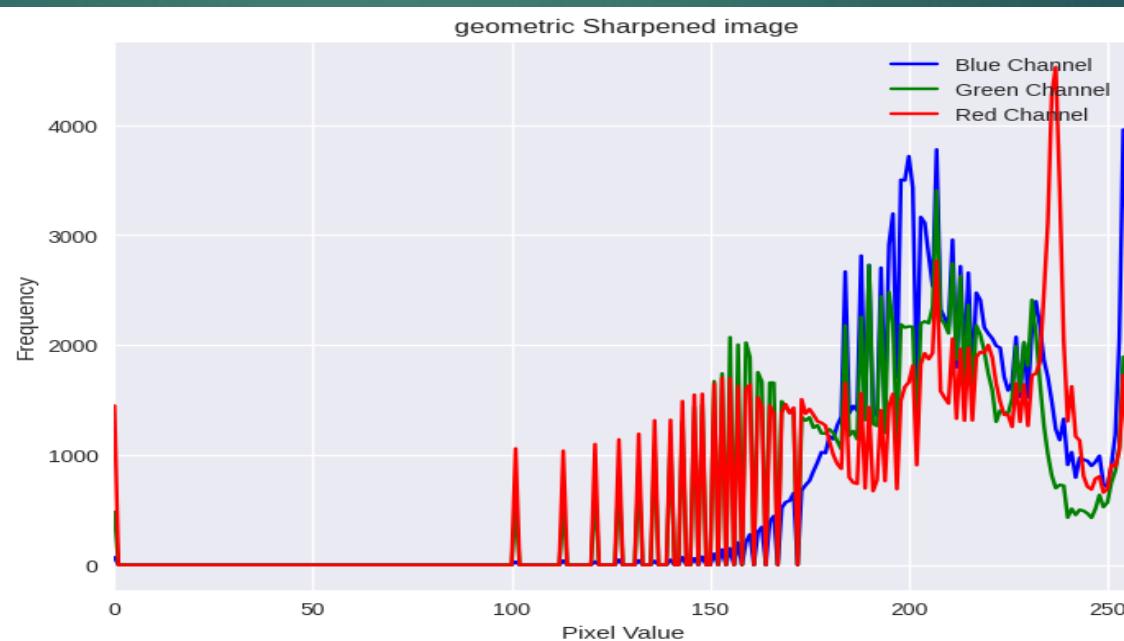


image statistics

Mean: 87.76

Variance: 4095.83

Median=72.0



Kernel=3

Exponent=1.5

G.Sharpened statistics

Mean: 202.95

Variance: 1063.78

median 206.0

Original image



4.Harmonic Sharpening

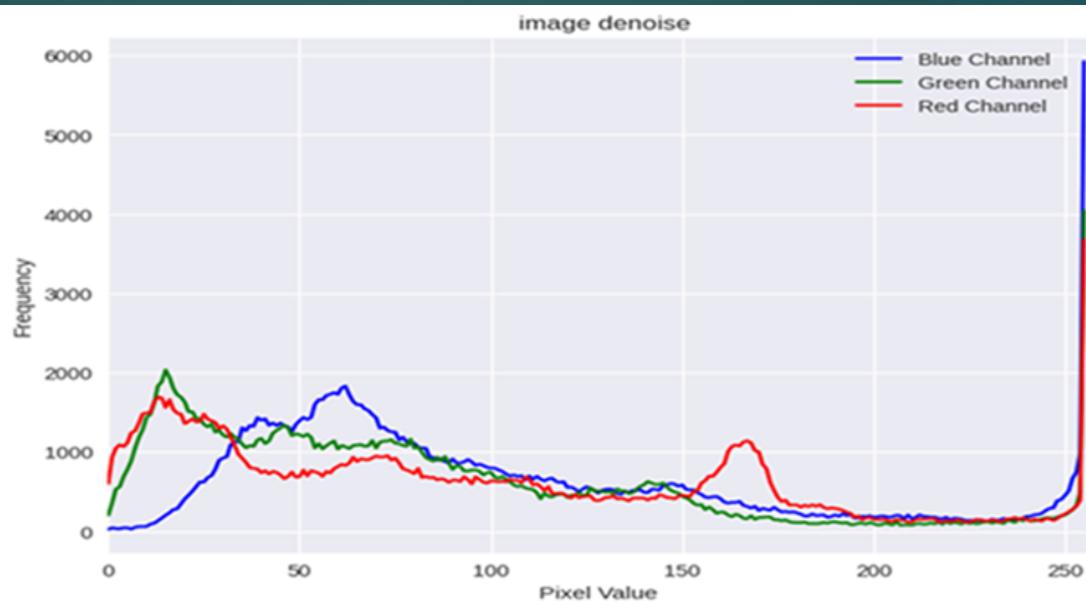


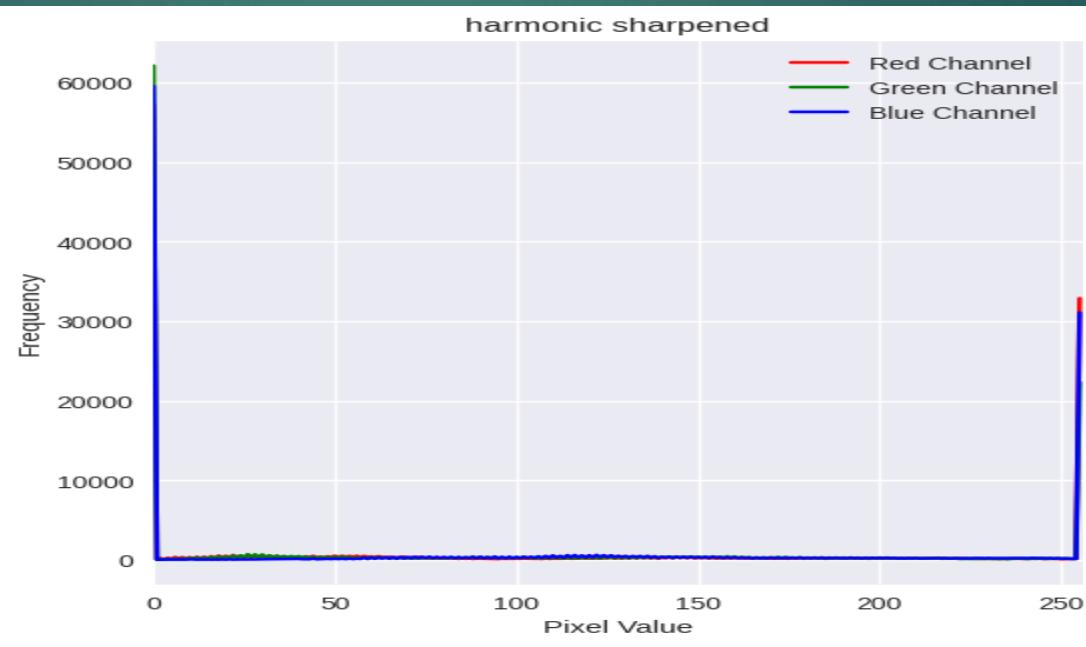
image statistics

Mean: 87.76

Variance: 4095.83

Median=72.0

Sharpened Image Harmonic



H.Sharpening Statistics

Mean: 100.46

Variance: 10374.36

median 70.0

Original Image

Mean: 90.88 Variance: 4411.78
Median=76.0

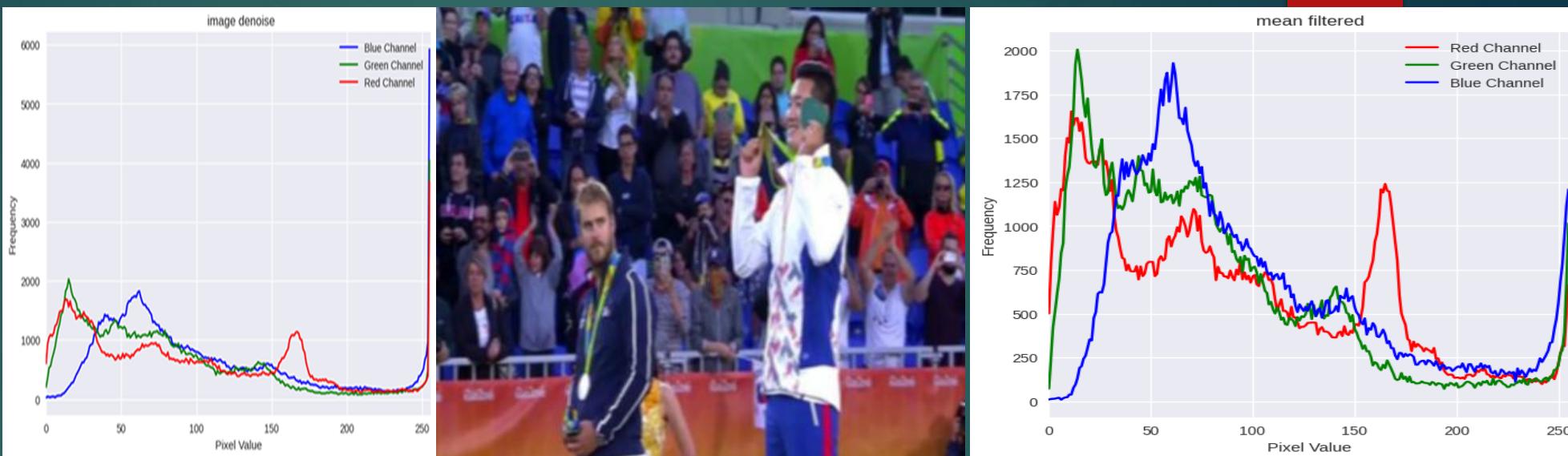


5. Mean Filter Sharpening

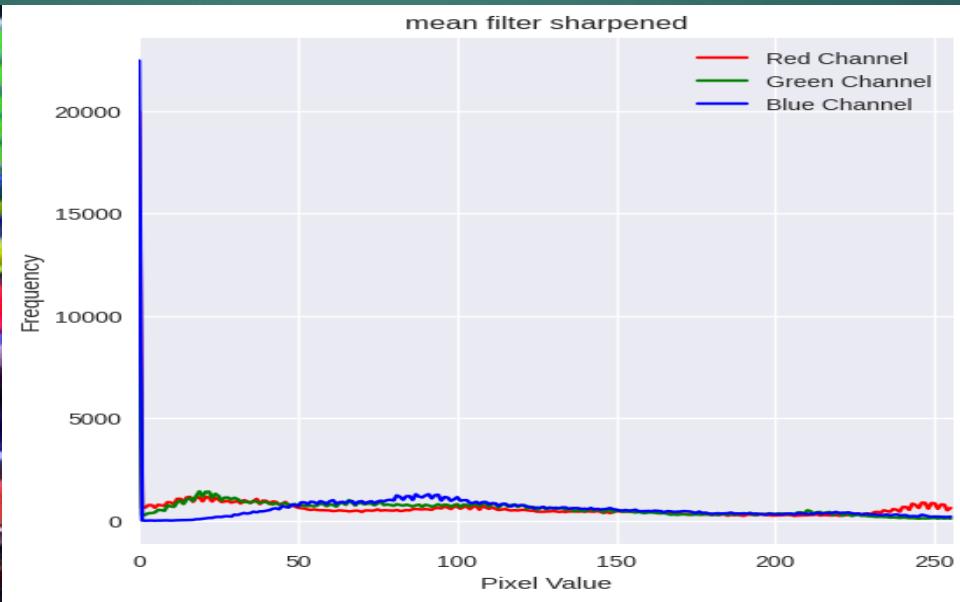
=Image-sharpening amount*mean filter

image statistics

Mean: 87.76 Variance: 4095.83 Median=72.0



Mean Filter Sharpening



Kernel=3
Sharpening=0.5

Mean Filter Sharpened Statistics
Mean: 123.92
Variance: 6253.23
median 108.5

Explain the major difference between your results.

For this project we have experiment 5 different mean methods for denoising and sharpening. For the chosen image for denoising and sharpening, we found that Harmonic mean filter for denoising seems to have a better output image among all 5 whereas geometric mean seems to have slightly different output.

Noised image statistics

Mean: 90.88

Variance: 4411.78

Median=76.0

Denoised Harmoic

Mean: 84.87

Variance: 3917.27

median 70.0

For the sharpening of image, we found three of sharpening methods better with slightly up and down in pixel, Geometric and harmonic seems to produce different result than aspected.

Mean Filter Sharpened Statistics

Mean: 123.92

Variance: 6253.23

median 108.5

Weighted Sharpening

Mean: 87.76

Variance: 4095.83

Median=72.0

Arithmetic Sharpening

Mean: 141.20

Variance: 8926.78

median 138.0

The reason for some of the methods not producing better results could be the values chosen for filtering and sharpening. It might also depends on characteristics of image. The over all assignment seems to be very informative and applicable to our project images to get clear and better pixel.

Application for the project

Both the methods denoising and image sharpening seems to be useful for our project. As some of images in the project have various types of noises and some need image sharpening to get better detailed information. Both these techniques will help the project to train our model with better images, which will produce better prediction results.

#####
#####The End#####
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