BRIEF REPORT

IMAGE SHARPENING AND SMOOTHING USING FILTERS

Aravind Menon(MIT2020049),Shubham Pandey(MIT2020050),Shubham Sahu(MIT2020051)

Group Code : G17_LT_A1

Indian Institute Of Information Technology Allahabad

Abstract

Images are used in various fields to help monitoring processes such as images in fingerprint evaluation, satellite monitoring, medical diagnostics, underwater areas, etc. The aim of this project is to remove noise and thus smoothen images using median and weighted mean filters. Removing noise is a very essential part of image processing. Image noises are of various types such as Gaussian noise, salt and pepper noise, speckle noise. We use MATLAB to compare the results obtained by passing noisy images through these filters in order to understand which filter works best.

Index Terms Sharpening, Smoothening, Mean Filter , Medain Filter, Histogram Equalization

1. Introduction

Image processing is a form of signal processing in which the input is an image, such as a photograph or video frame and the output may be either an image or a set of characteristics or parameters related to the image. An image can be enhanced by changing any attribute of the image. There exist many techniques that can enhance an image without spoiling it. Enhancement methods can be broadly divided into two categories i.e. spatial domain technique and frequency domain technique.

Image smoothing is a process used to remove the noise and also to preserve the quality of the image. Noise which could corrupt images are of different types such as additive, multiplicative and impulsive. We are going into two types of noise, the speckle noise and salt and pepper noise.

Speckle Noise. This type of noise is essential to be removed as it occurs in medical images. Ultrasound imaging, which is used for medical purposes are corrupted by this noise and this can lead to wrong results[3]. A speckle noise is a multiplicative noise and hence it can be modelled by multiplying its pixel values. A model of speckle noise implementation and analysis is provided by[4].

Salt and Pepper noise. It is a popular kind of impulse noise because the pixels can only take extreme values, that is, 0 for white(salt) or 1 for black(pepper). Non-linear filter such as median filter is effective in removing this type of noise. Another type of filter to remove this is given in [5]

2. Related Work About Topic (Smoothening and Sharpening Filters)

Weighted Mean Filter A mean filter is a linear filter as the output pixel is a linear combination of the nearby input values. This filter computes a weighted average of pixels in the window. An example of this process is explained in Fig(1) If

2	3	1	3
1	6	6	2
1	3	4	1
3	4	1	7

fig (1)

the mask size 2*2, the overlapping matrix for index (0,0) is given below in fig (2)

2	3
1	6

Average = (2+3+1+6)/4=3

$$\begin{matrix} & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \\ \cdots & 8 & 5 & 8 & 8 & 5 & 8 & \cdots \\ \cdots & 8 & 5 & 8 & 8 & 5 & 8 & \cdots \\ \cdots & 8 & 5 & 8 & 8 & 5 & 8 & \cdots \\ & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \end{matrix} * \frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix} = \begin{matrix} & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \\ \cdots & 7 & 7 & 7 & 7 & 7 & 7 & \cdots \\ \cdots & 7 & 7 & 7 & 7 & 7 & 7 & \cdots \\ \cdots & 7 & 7 & 7 & 7 & 7 & 7 & \cdots \\ & \vdots & \vdots & \vdots & \vdots & \vdots & \vdots & \end{matrix}$$

. fig(2)

A convolution is a one-to-one linear function F that maps an M x N image Z and a N x N convolution kernel C onto a new M x N image W. The function F has the following properties: 1) A pixel from Z is mapped to the same position in W. 2) If the convolution kernel C is given by

$$\begin{vmatrix} C1 & C2 & C3 \\ C4 & C5 & C6 \\ C7 & C8 & C9 \end{vmatrix} \text{ And}$$

$$\begin{vmatrix} Z1 & Z2 & Z3 \\ Z4 & p & Z5 \\ Z6 & Z7 & Z8 \end{vmatrix}$$

is a neighborhood about a pixel p in Z, then p is mapped by the convolution function to a pixel q in W where

$q = c1*z1 + c2*z2 + c3*z3 + c4*z4 + c5*p + c6*z5 + c7*z6 + c8*z7 + c9*z8$

The above definition which is stated for a 3 x 3 image neighborhood and 3 x3 convolution kernel can easily be generalized to a N x N image neighborhood with an N x N convolution kernel

Median Filter. In this filter, we take the median values of adjacent pixels. The algorithm involves sorting all the pixel values and taking the median. This method has a higher computational complexity compared to mean filter. Another version of median filter is one where only the pixel values which are greater than the median is changed [6]

3. Algorithm Analysis

Histogram Equalization can be considered as redistribution of the intensity of the image. Color histogram equalization can be achieved by converting a color image into HSV/HSI image and enhancing the Intensity while preserving hue and saturation components.

However, performing histogram equalization on components of R,G and B independently will not enhance the image. At the end of this post, check the histogram of before and after histogram equalization of an image which is obtained by performing histogram equalization on the components(R,G and B) independently

Steps to be performed:. 1. Convert RGB image into HSI Image. 2. Obtain the 'Intensity Matrix' from the HSI Image matrix 3. Perform Histogram Equalization on the intensity Matrix 4. Update the Intensity Matrix from the HSI Image matrix with the histogram equalized Intensity matrix 5. Convert HSI Image back to RGB Image

Steps to be performed for Median and Mean Filter: 1. Convert RGB image into GRAY Image 2. Applying noise and give noisy image as input to both the filter 3. Then results are comapared for image

4. Experiment

Histogram equalization

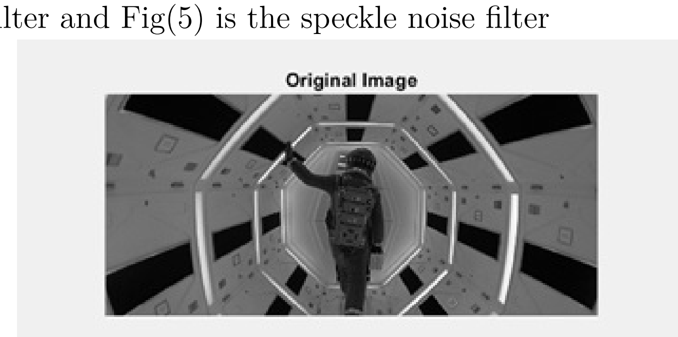
In Histogram equalization RGB image matrix is converted into HSI (Hue , Saturation and Intensity) format and histogram equalization is applied only on the intensity matrix . The Hue and Saturation matrix remain the same. The updated HSI image matrix is converted back to RGB image matrix

Before Histogram Equalization

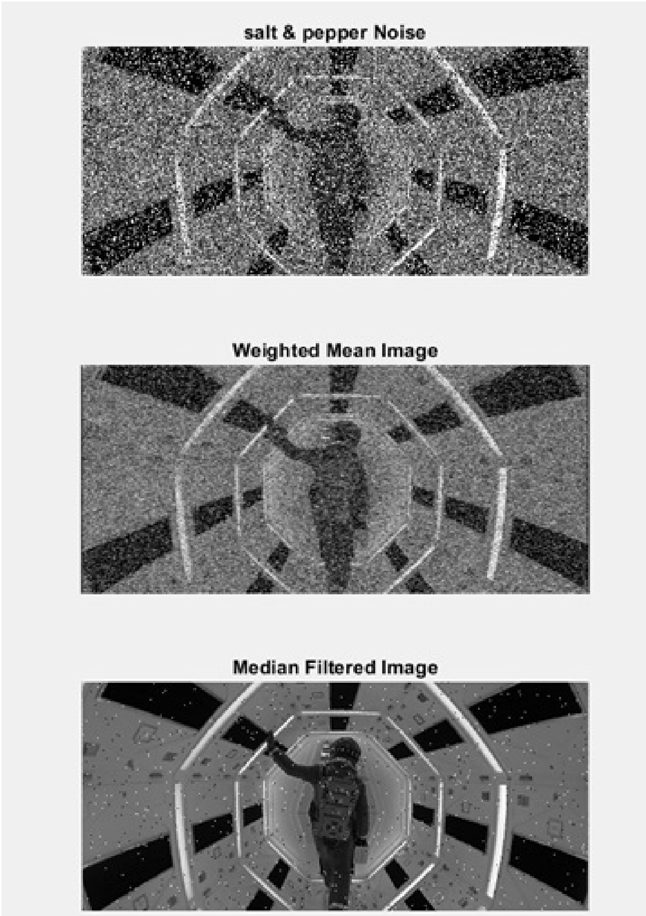
After Histogram Equalization

Median And Mean Filter

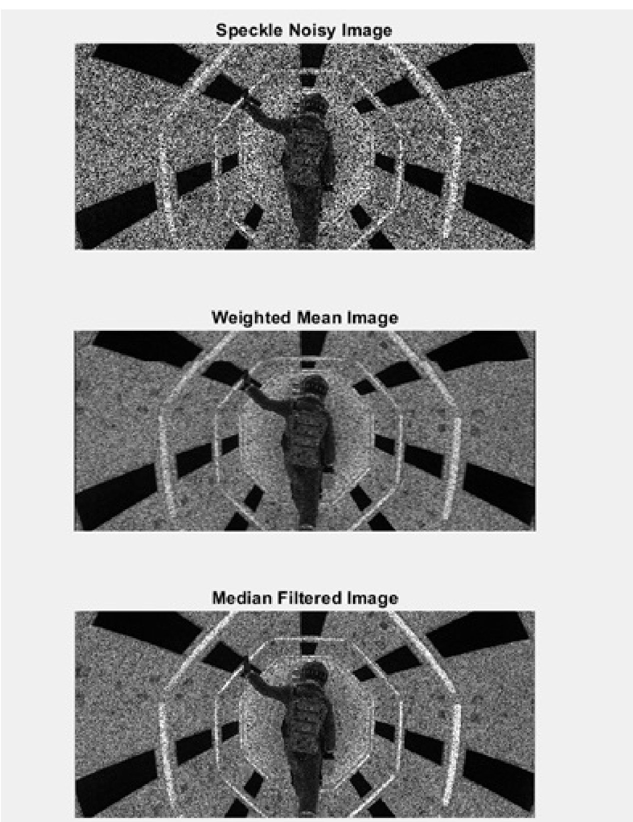
The filters are simulated using MATLAB. The images are contaminated with both kinds of noise and they are given to both filters. Fig(3) is the original image, Fig(4) is the salt and pepper noise filter and Fig(5) is the speckle noise filter



Fig(3)



Fig(4)



Fig(5)

5. Conclusion

In this paper filters are simulated using MATLAB. Median filtering has also been applied to the area of edge-preserving smoothing in hopes of obtaining better noise cleaning results. The median filtered output image is more smoothened for salt and pepper noise than compared to Speckle noise. Sharpening is the reverse process of smoothing and are useful for highlighting edges in an image and it is done using Histogram Equalization.

6. References

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