Image Filtering and Application of Different Filters

AJAY KUMAR GAUTAM

204102323

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Abstract

Noise removal from image is one of the most important thing in digital image processing.Noise should be removed from an image in such a way that important information of image should be preserved. In this project we will find the application of different filter.We will apply different filter to an image and observe the corresponding filtered output image. Such filters are as Mean filter,Median filter,Max filter ,High pass filter,Gaussian filter,Laplacian filter,Wiener filter etc.

Introduction

In digital image processing filters are mainly used to suppress either the low frequencies which means smoothing the image or high frequencies which means enhancing or detecting the edges in the image.In this we will see the application of different filters and what is purpose of different filter which can be applied to an image.The filters are Mean filter ,median filter,max filter ,laplacian filter,gaussian filter ,wiener filter etc.

Figure 1: input image

Different filters and their applications

Low Pass filter

This filter is also known as smoothing filter.Low pass filter eliminates the high frequency content from an image.The application of low pass filter is smoothing the image and preserve the low frequency content.It preserve the object appearance.The mask 3*3 is given as follows:

$$M(m,n) = \begin{bmatrix} \frac{1}{9} & \frac{1}{9} & \frac{1}{9} \\ \frac{1}{9} & \frac{1}{9} & \frac{1}{9} \\ \frac{1}{9} & \frac{1}{9} & \frac{1}{9} \end{bmatrix} \tag{1}$$

The filtered output image is obtain as:

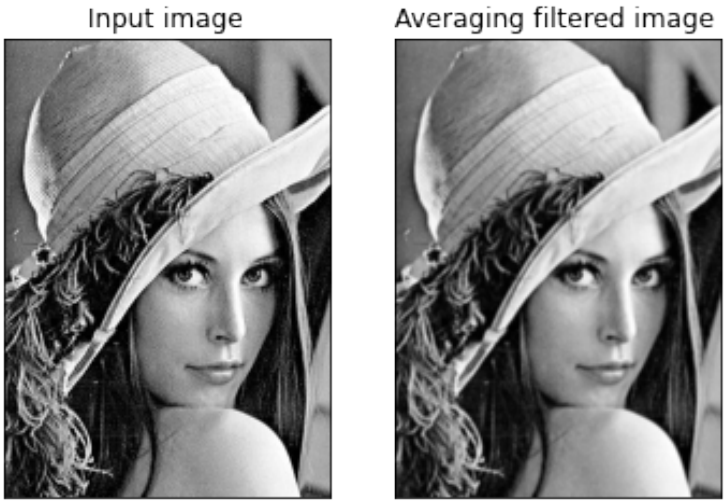

Figure 2: Low pass filtered image

High pass filter

It removes the low frequency components while enhancing the high frequency region.High pass filter is used to find the high frequency components such as edges etc.The main application of high pass filter is to find the edges and boundaries of an image .The 3*3 mask is given as :

$$M(m,n) = \begin{bmatrix} \frac{-1}{9} & \frac{-1}{9} & \frac{-1}{9} \\ \frac{-1}{9} & \frac{8}{9} & \frac{-1}{9} \\ \frac{-1}{9} & \frac{-1}{9} & \frac{-1}{9} \end{bmatrix} \tag{2}$$

If we apply this mask to an image the we get edges and boundaries of that image .

The filtered image output is obtain as :

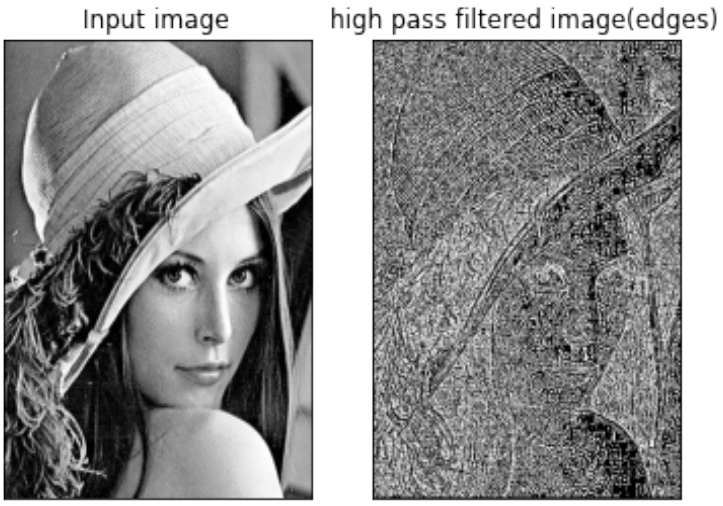

Figure 3: High pass filtered image

Median Filter

Median filter is a nonlinear filtering method to remove the noise from images. It is very effective at removing noise while preserving edges.The particular application of median filter is removing salt paper noise type noise.It works by moving through the image pixel by pixel ,replacing each value with the median value of neighbouring pixel .

The median filtered output image is obtain as:

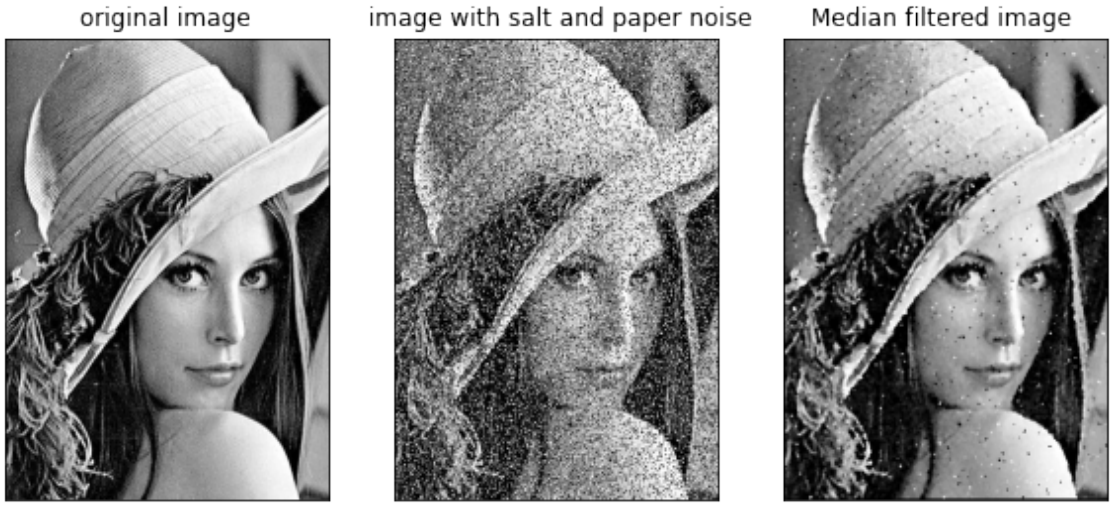

Figure 4: Median filtered image

Max RGB filter

The maximum RGB filter is very useful to use when visualizing the red green and blue channel of an image and which channel contributes most to a given area of an image .This is also use for simple

colour based segmentation.For every pixel of image,this filter holds the channel with the maximum /minimal intensity .THe result is an image with only three colors red,green,and blue and possibly pure gray .

The filtered output image is obtain as :

Figure 5: Max RGB filtered image

Gaussian filter

Gaussian filter is a LPF for removing the noise i.e high frequency and blurring region of an image .In this sense gaussian filter is similar to mean or averaging filter but gaussian filter uses different kernel that represent the shape of a Gaussian hump .In 2-D ,an isotropic Gaussian has the form

$$G(x,y) = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{x^2+y^2}{2\sigma^2}\right) \tag{3}$$

The 5*5 kernel of Gaussian filter is given as ::

$$M(m,n) = \frac{1}{273}\begin{bmatrix} 1 & 4 & 7 & 4 & 1 \\ 4 & 16 & 26 & 16 & 4 \\ 7 & 26 & 41 & 26 & 7 \\ 4 & 16 & 26 & 16 & 4 \\ 1 & 4 & 7 & 4 & 1 \end{bmatrix} \tag{4}$$

When we apply this kernel to an image then output image is obtain as :

Laplacian filter

Laplacian is a 2-d isotropic measure of second spatial derivative of an image. The laplacian of an image highlights regions of rapid intensity change and so it is often used for the edge detection of an

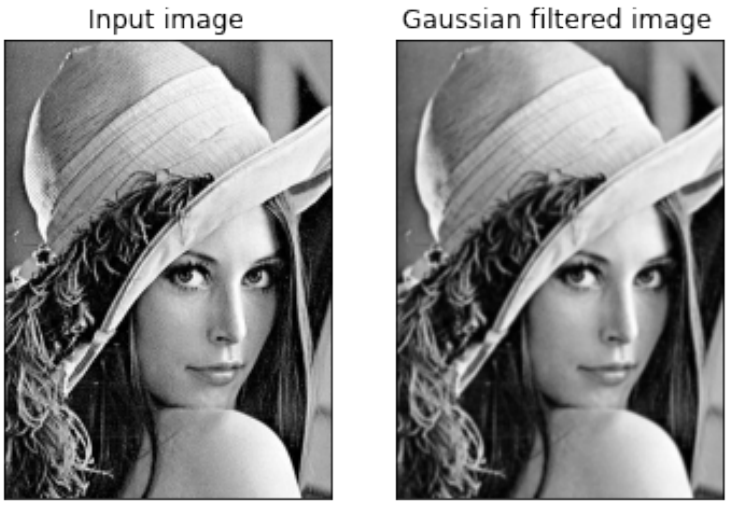

Figure 6: Gaussian filtered image

image.The laplacian L(x,y) of an image with pixel intensity values I(x,y) is given as In laplacian filter two commonly used small kernels are as follows:

$$L(x,y) = \begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & -1 \\ 0 & -1 & 0 \end{bmatrix} \tag{5}$$

$$L(x,y) = \begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix} \tag{6}$$

When we apply this kernel to an image then output image is obtain as :

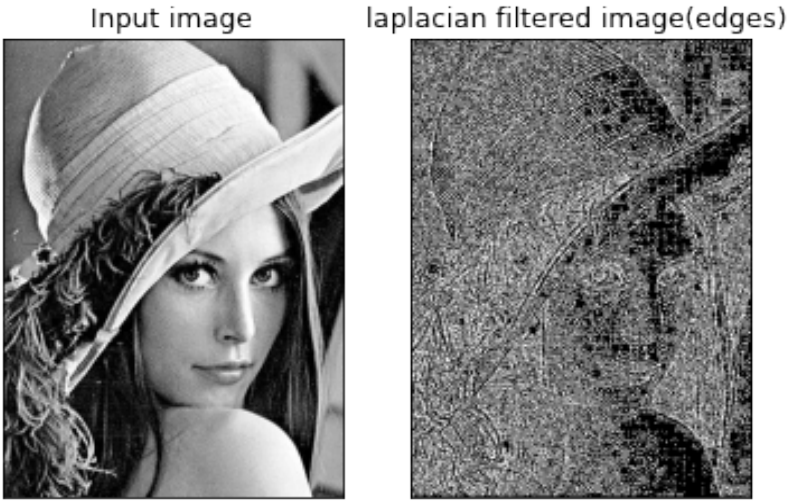

Figure 7: Laplacian filtered image

Wiener filter

Wiener filter is used for removal of blur in an image due to linear motion or unfocussed optics .The objective of image restoration is to restore a degraded image to its original form . the image degradation can modelled as a convolution of the input image f(x,y) with a linear shift invariant filter h(x,y). For example h(x,y) may be considered as gaussian function i.e.

$$h(x,y) = \frac{1}{2\pi\sigma^2} \exp\left(-\frac{x^2+y^2}{2\sigma^2}\right) \tag{7}$$

so G(x,y) = h(x,y)*f(x,y)

The filtered image can be obtain as:

Figure 8: Wiener filtered image

Table

Table 1: Application of filters

index	filter	application
1	low pass filter	smoothing and preserve the low frequency component
2	high pass filter	find the edges and boundary ,high frequency component
3	median filter	remove salt and paper noise
4	gaussian filter	smoothing
5	laplacian filter	edge detection
6	max RGB filter	color based segmentation ,which channel contributes most to a given area of an im
7	wiener filter	remove blur in an image due to linear motion

Conclusion

We can say that every filter has its own advantage and application . Depending on the requirement we use different filters for different application. In this paper we proposed the application of filters such as low pass filter used for smoothing and preserving the low frequency component ,high pass filter is used for analysis for high frequency component such as edge and boundary of an image .Median filter is used for removal of salt and paper noise .Gaussian filter is used for smoothing .Wiener filter is used for removal of blur in an image due to linear motion.

References

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