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Effect Comparison of Some Filters on Images

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Abstract

The study aims to enhance the processing of distorted digital images by applying filters like Low pass filter, High pass filter, Median filter, Mean filter, Max filter, Min filter, and High-boost filter. These filters depend on the modalities of the spatial and frequency domains, which use the method of blocking an image by window N * N.

The study has been applied to binary image, grayscale image, and color image. With using kinds of noise such as salt and pepper noise, Gaussian noise, Speckle noise, and Poisson (Shot) noise.

Processing was applied to a set of images to ensure the efficiency of the filters. In our work, a comparison was made between the results of these filters effect on the images.

Keywords: Linear r filter, Nonlinear filter, Low pass filter, High pass filter, Median filter, Mean filter, Max filter, Min filter, High- boost filter .

الملخص

تهدف الدراسة إلى تحسين عملية معالجة الصور الرقمية المشوهة بتطبيق مجموعة من المرشحات مثل مرشحات التمرير المنخفض، مرشحات التمرير المرتفع، المرشح الوسطي، المرشح المتوسط ، مرشح الحد الأدنى، مرشح الحد الاقصى ومرشح التعزيز المرتفع. تعتمد هذه المرشحات على أشكال المجال الترددي والمكاني، والتي تستخدم طريقة حجب الصورة بواسطة النافذة .n*n

أجريت الدراسة على أنواع من الصور منها الصورة الثنائية، الصورة ذات التدرج الرمادي و الصورة الملونة. كما استخدمت أنواع من الضوضاء على الصور منها ضوضاء الملح والفلفل، ضوضاء جاوس، ضوضاء الرقطة، ضوضاء بواسون(الطلقة).

طبقت الدراسة على مجموعة من الصور لاظهار كفاءة المرشحات المستخدمة ، وتم عمل مقارنات بين نتائج تأثير تلك المرشحات على الصور.

1. Introduction

Playing digital image processing has an important role in the world in terms of programming and presentation of data processing on the computer. Image processing mainly depends on enhancement, restoration, and compression.

The interest in addressing digital images is based on two foundations and principles:

1. improve the image by the interpreted information from the human.
2. data processing of a particular scene by
3. automatic observation.

This study has been conducted to identify some types of filter focusing on filters low pass filter, High pass filter . Median filter, Mean filter, Max filter, Min filter, High- boosting filter and compared their impact on the images. The filters have been applied binary image, grayscale image, and color image using kinds of noise, such as salt and pepper noise, Gaussian noise, Speckle noise, and Poisson (Shot) noise [2].

This study has examined the effect on image filters. Some will smooth the image and some will hurt the features and hide them from the edges. This determines which works to change the intensity of light [1] .

The filters can be classified into two main types: -

1- Linear filters including:
- low pass filter.
- High pass filter.
- High-boost filter.
- Mean filter

2- Nonlinear filters including:
- Max filter.
- Min filter.
- Median filter.

It is important to point out that some filters work on smoothing images, which are called smoothing filters, and others work to determine the edges of the image and are called sharping filters.

2.Classified Filters

2.1- Linear filters

2.1.1 -Low pass filter:

Where low pass to remove (high frequency) components [3][6].

Low pass filter types:

- Ideal low pass filter
- Butterworth low pass filter
- Gaussian low pass filter

2.1.2 -High pass filter:

Because edges and other abrupt changes in gray levels are associated with high-frequency components, image sharpening can be achieved in the frequency domain by a high pass filtering process, which attenuates the low-frequency components without disturbing high-frequency information in the Fourier transform.

Only the edges are predominant in the image because the low-frequency components were severely attenuated [3] [6].

High pass filter types:

- Ideal High pass filter
- Butterworth High pass filter
- Gaussian High pass filter

2.1.3 -High-boost filter:

It has been used to enhance the high-frequency components while still keeping the low- frequency components.

The high-boost filter is a simple sharpening operator in signal and image processing [5].

High-boost = (A-1) (original) + (high pass)

2.1.4-Mean Filter:

Candidate an average of linear filters. This candidate compensates for new points for each site (X, Y) by ratinge points in the local window N * N. If every point in the distorted image is at a local window N*N point in stages, the picture will enjoy it because the element rate will reduce average noise to ward zero. Average candidate is a simple filter for all kinds of noise but is more efficient r to remove noise added [1] .

$$\text{Arithmetic Mean} = \frac{1}{N^2} \sum_{(r,c)\in W} f(r,c)$$

2.2- Nonlinear Filters

2.2.1 -Max filter:

Select the largest value amongst the ordered values of pixels from the windows.

This filter can be used to eliminate the pepper noise [3].

2.2.2 -Min filter:

Select the smallest value amongst the ordered values of pixels from the windows.

This filter can be used to eliminate the salt noise [3].

2.2.3-Median filter:

It is a nonlinear operation often used in image processing to reduce "salt and pepper" noise?.

A median filter is more effective than convolution when the goal is to simultaneously reduce noise and preserve edges [1].

y(t) = median ((x(t-T/2), x(t-T1+1), …,x(t),…,x(t +T/2))

3. Types of Images

Image is two-dimensional function, f (x, y), where x and y are spatial (plane) coordinates[8][9].

3.1 Color images:

A (digital) color image is a digital image that includes color information for each pixel.

Figure (8) Color image

3.2 Gray scale images:

A grayscale (or gray level) image is simply one in which the only colors are shades of gray. The reason for differentiating such images from any other sort of color image is that less information needs to be provided for each pixel.

Figure (9) Gray scale image

3.3 Binary images:

A binary image is a digital image in which each pixel has only two possible values. Typically, the two colors used for a binary image are black and white, though any two colors can be used .

Figure (10) Binary image

4. Types of Noise

Noise is any degradation in the image signal , caused by external disturbance[7].

4.1 Salt and Pepper noise:

It is caused by sharp, sudden disturbances in the image signal, and it consists of randomly scattered white or black (or both) pixels. It can be modeled by adding random values to an image.

Figure (11) Salt and pepper noise

4.2 Gaussian noise:

It is an idealized form of white noise, which is caused by random fluctuations in the signal.

Figure (12) Gaussian noise

4.3 Speckle noise:

It is a major problem in some radar applications. It can be modeled by random values multiplied by pixel values.

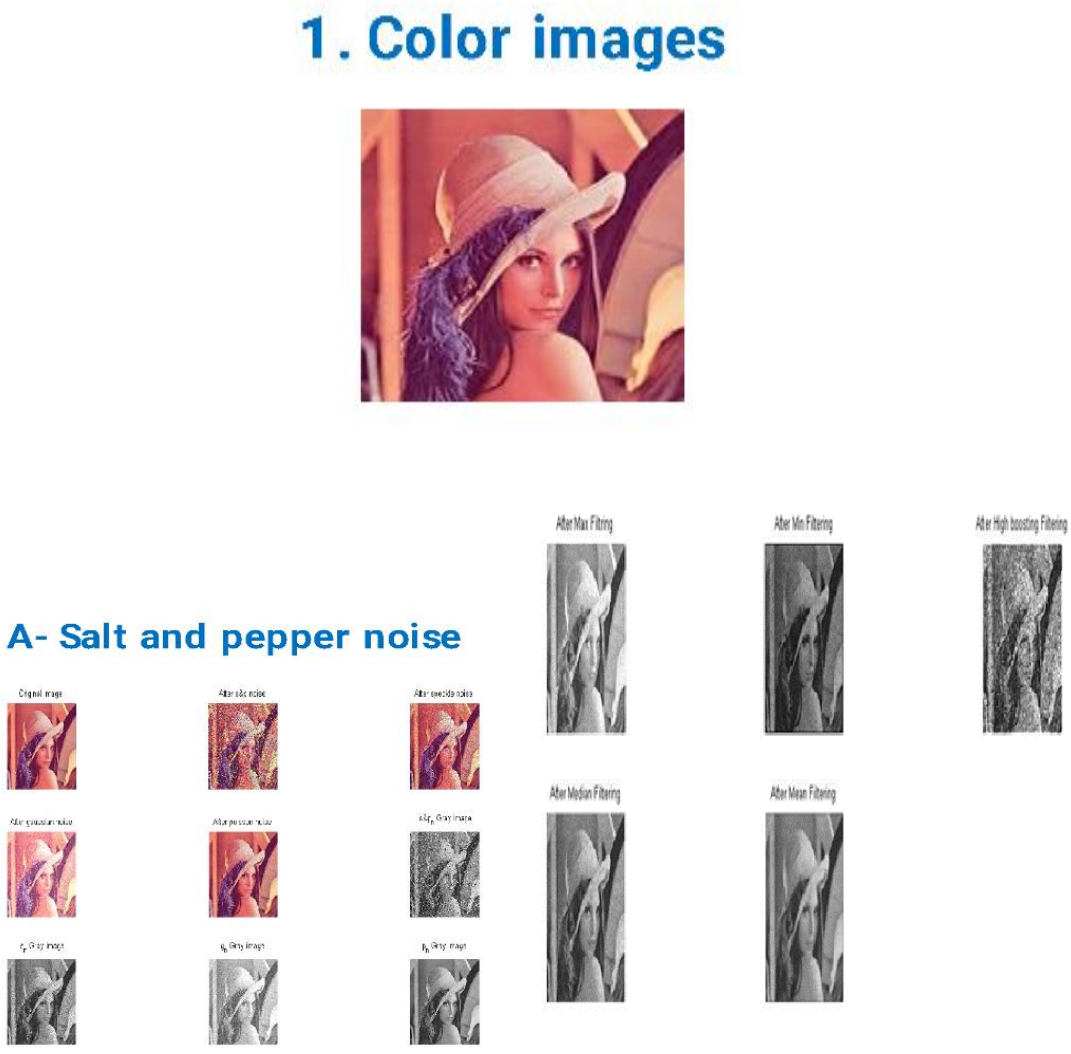
Figure (13) Speckle noise

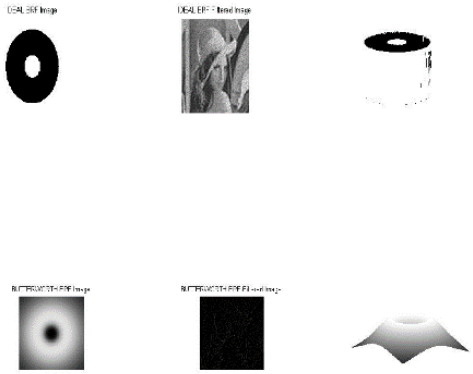
4.4 Poisson (Shot) noise :

It is a type of noise that originates from the discrete nature of electronic electric charges. The term also applies to photon counting in optical devices, where shot noise is associated with the particle nature of light.

Figure (14) Poisson (Shot) noise

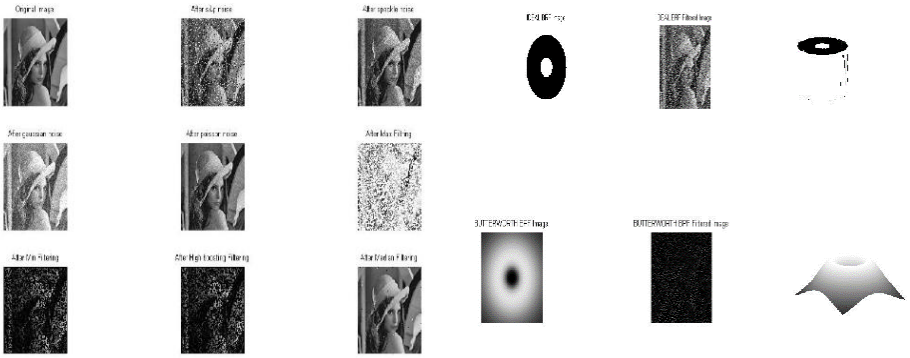
5-Results



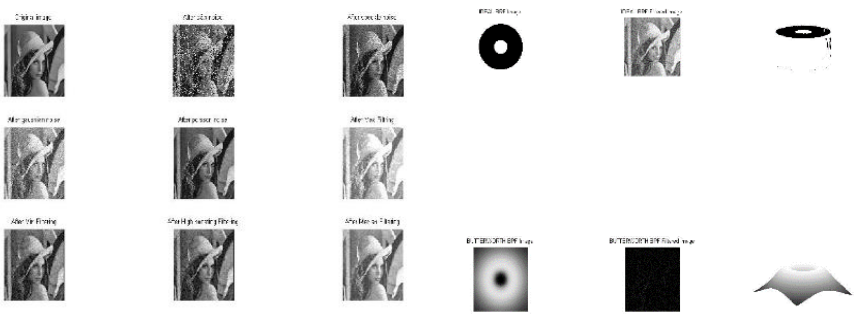


2. Gray scale images

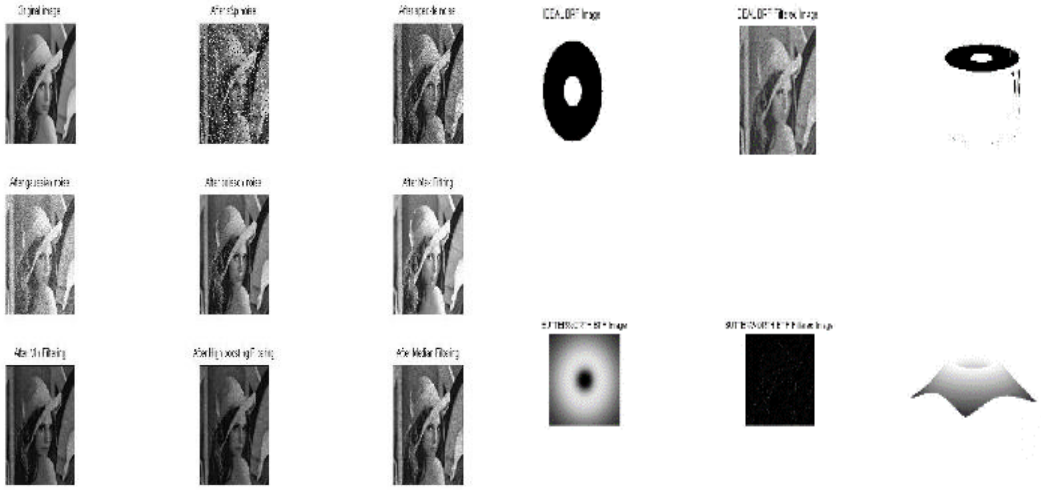
A- Salt and pepper noise



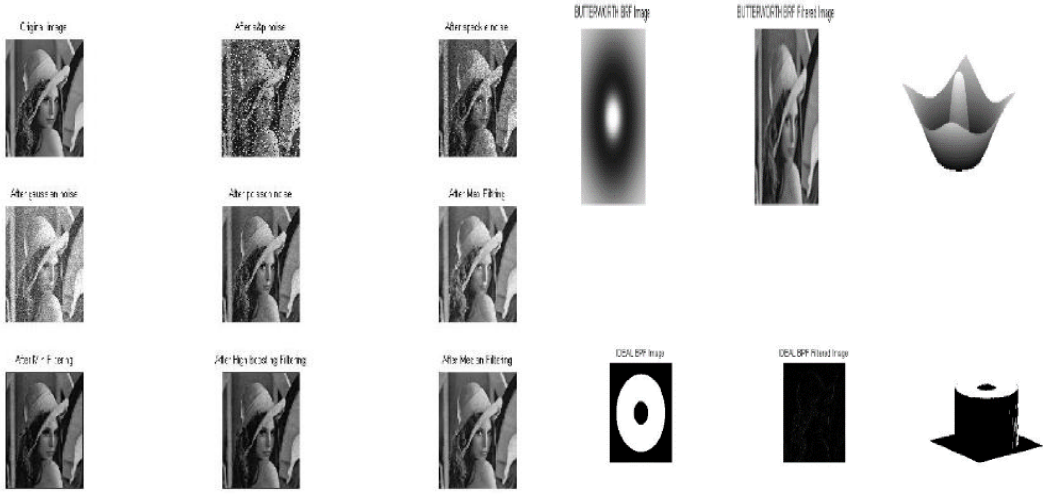
B- Gaussian noise



C- Speckle noise

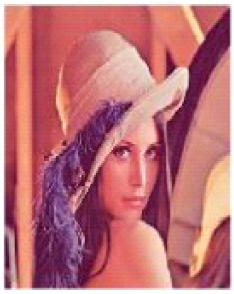


D- Poisson noise



3. Binary images

Original image



Double image

6. Conclusion

-To reduce noise, one or more filters are sometimes required.
-Some of the original information is always lost in the filtering process.
-In the binary images, it is noted that we cannot apply noise to them. On the other hand, noise can be applied to both color and grayscale images.
-There are two types of filters that have similar results, which are median and mean filters (average).

7.References

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