The Effect Of The Weiner And Median Filler For Image Noise Removal

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Abstract
Image processing is basically the use of computer algorithms to perform image processing on digital image. Digital image processing is a part of digital signal processing and has many significant advantages over analog image processing. Also allows a much wider range of algorithms to be applied to the input data can avoid problems such as the build-up of noise and signal distortion during processing of images .Wavelet transforms have became a very powerful tool for de- noising an image.one of the most popular methods is wiener filter. In this work two types of noise (Gaussian noise and salt noise) is used and De- noised image by wiener filter and median filter. The results have been compared for all filter and noises.

الخلاصة
تعتمد المعالجة الصورية على استخدام خوارزميات الحاسوب لإنجاز عملية المعالجة على الصورة الرقمية. إن معالجة الصورة الرقمية هي جزء من معالجة الإشارة الرقمية ولها فوائد متعددة أكثر من الصورة الاعتيادية. ان المعالجة تسمح لخوارزميات كثيرة للعمل على البيانات الداخلة والتي بإمكانها تجنب المشاكل، والتي تخص مثلاً نشوء الضوضاء وتشوه الإشارة اثناء المعالجة الصورية . من الادوات التي أصبح لها تأثيراً كبيراً في إزالة الضوضاء هي استخدام التحويلة المويجية، وكذلك هناك طريقة شائعة وهي مرشح وينر. ومن خلال هذا البحث سنستخدم نوعان من الضوضاء وهما ضوضاء كَاوس (Gauss Noise) وضوضاء الملح _ بهار (Salt– Pepper Noise)، وكذلك اثنان من المرشحات وهما وينر (Wiener Filter) والمرشح الوسيط (Median filter).

Introduction
The image corrupted different kinds of noises is a frequently encountered problem in image acquisition and transmission (Gonzalelz and woods (2001)).There are many ways to de-noise an image or a set of data and methods exists.The important property a good image de- nosing model is that is should completely remove noise as far as possible as well as preserve edges. traditionally, there are two types of models i.e. linear model and non- linear model. Generally, linear models are used. The linear noise models benefits are the speed and the limitation of the linear models, the models are not able preserve edge of the image in an efficient manner i.e. the edge, which are recognized as discontinuities in the image; are smeared out. On the other hand, non- linear models can handle edges in a much better way than linear models. One popular model for nonlinear image de- noising is the Total variation (TV)- filter. The suggestion to de- noise a degraded image x given by x=S+N, where S is the original image and N is an Additive white Gaussian noise with unknown variance (David. Donoho's website)

Image Noise
It is the random variation of brightness or color information in image produced by the sensor and circuitry of a scanner or digital camera. It can also originate in film grain in the unavoidable shot noise of an ideal photo detector (Charles Boncelet (2005)).

It is generally regarded as an undesirable by- product of image capture. Although, these unwanted fluctuation become known as "noise" by analog with unwanted sound they are inaudible and such as dithering. The types of noise are Gaussian noise salt & pepper noise poison noise and speckle noise.

In this work two types of noise Gaussian noise and salt & pepper is used and image de-noising performed by median filter and Wiener Filter.

Median Filter

Most of the classical non- linear digital image filter, such as averaging low pass filter have been characteristic and they tend to blur edges and to destroy lines, edges and other fine image details. One solution to this problem is the use of the median (MED) filter, which is the most popular order statistics filter under the nonlinear filter classes (pitas and venetsanopoulos (1997)).

Median filter is very widely used in digital processing because under certain conditions, it preserves edges whilst removing noise.

The main idea of the median filter is to run through the signal entry by entry, replacing each with the median of neighboring entries.

Note that if the window has an add number of entries, then the median is simple to define: it is just the middle value after all the entries in the window are sorted numerically. For an even number of entries, there is more than one possible median. A major advantage of the median filter over linear with extremely large magnitudes

The output Y(t) of the median filter to the moments adjacent to t: (James. Church, yixinchen and Stephen. Rice (2008)).

$$Y(t) = median\ ((x(t - t/2), x(t - T + 1), \ldots, x(t + t/2))\ldots \quad (1)$$

Where t is the size of the window of the median filter.

Normally images are represented in discrete from two dimensional arrays of image elements, or "pixels" i.e. sets of non- negative value Bij ordered by two indexes.

I=1,…, Nx (rows) and j=1,…, Ny (column)

Where the element Bij are scalar values, there are methods for processing color images, where each pixel is represented by several values, e.g. by its red, green, blue values determining the color of the pixel.

Wiener filter

The goal of the wiener filter is to filter out noise that has corrupted signal. It is based on a statistical approach typical filters are designed for a desired frequency response. The wiener filter approaches filtering from a different angle. One is assumed to have knowledge of the spectral properties of the original signal and the noise, and one seeks the filter whose output would come as close to the original as possible (kazubek (2003)). Wiener method implements spatial smoothing and its model complexity control correspond to choosing the window size (Jain (1999)).

Wiener filter in the wavelet domain yield optimal when the signal corruption can be modeled as a Gaussian process and the accuracy criterion the mean square error (MSE)

Wiener filters are characterized by the following:

a. Assumption: signal and (additive) noise are stationary linear random processes with known spectral characteristics.

b. Requirement: the filter must be physically realizable, i.e. causal (this requirement can be dropped, resulting in a non-causal solution).

c. Performance criteria: minimum mean- square error.

Wiener Filter in the Fourier Domain

The wiener filter is: (strela (2000), choi and baraniuk (1998)).

$$G(u,v) = \frac{H^{*}(u,v)P_{s(u,v)}}{|H(u,v)|^{2}\ P_{s}(u,v) + P_{n(u,v)}} \quad \ldots\ldots(2)$$

Dividing through by *Ps* makes its behavior easier to explain:

$$G(u,v) = \frac{H^*(u,v)}{|H(u,v)|^2 + \frac{P_{n(u,v)}}{P_{s(u,v)}}} \qquad \ldots\ldots\ldots\ldots..(3)$$

Where:

$H(u,v)$ = Degradation function

$H^*(u,v)$ = complex conjugate of degradation function

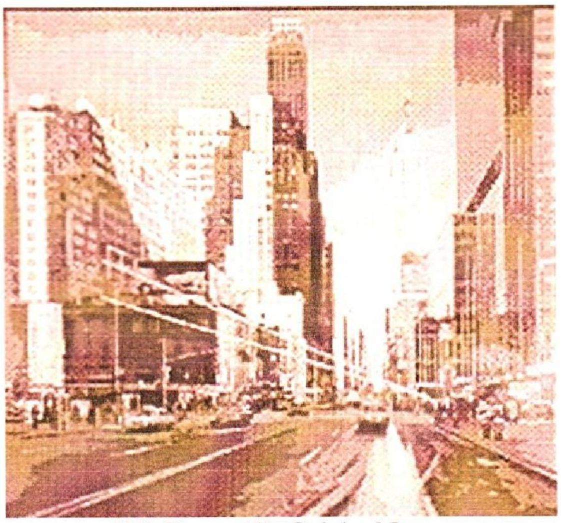
$P_n(u,v)$ = power spectral Density of Noise.

$P_s(u,v)$ = power spectral Density of un- degraded image.

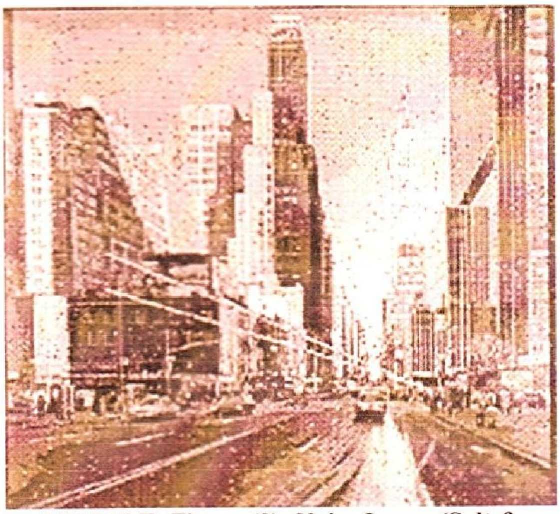
The term P_n/P_s can be interpreted as the reciprocal of the signal to- noise ratio.

The Results:

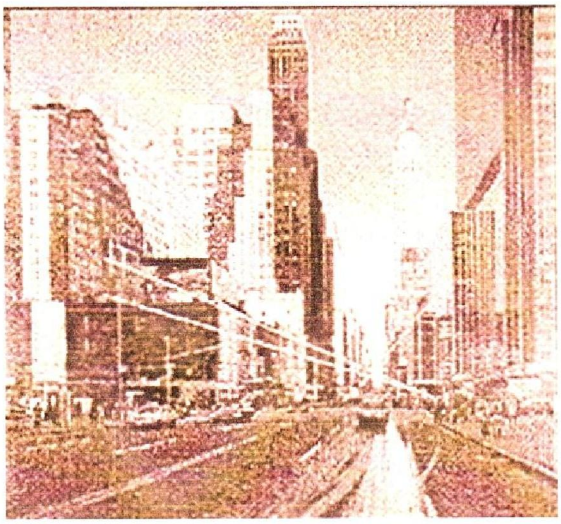
The original image Mg & SG adding two types of noise (Gaussian noise and salt & pepper noise) and De- noised image using median filter and wiener filter and comparisons between them.



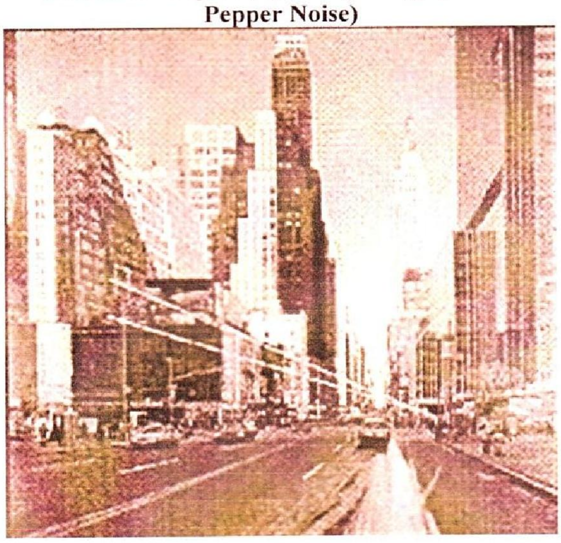
MG-Figure (1): Original Image



MGSALT- Figure (2): Noisy Image (Salt & Pepper Noise)

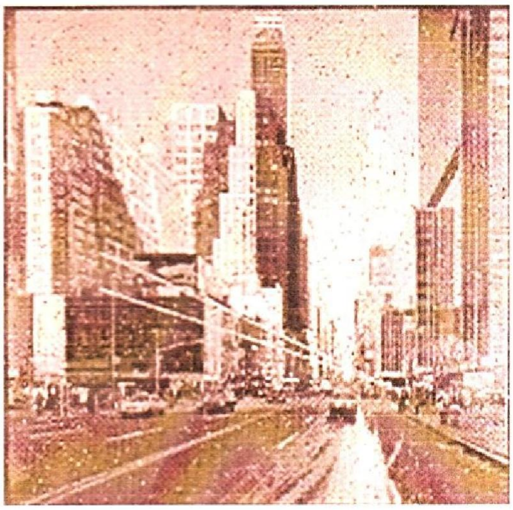


MG GAUS-Figure (3): Noisy Image (Gaussian Noise)

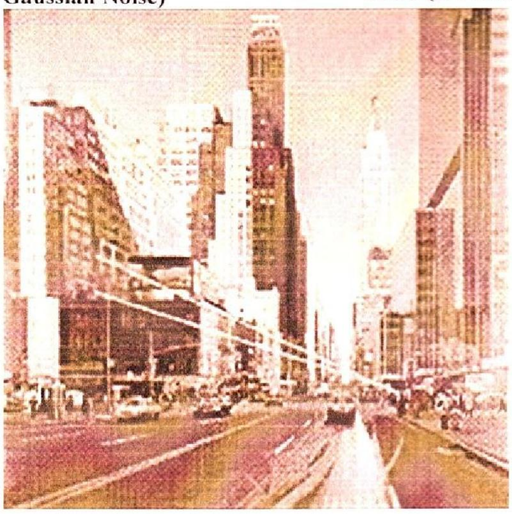


MG GAUSWIN-Figure (4): De-Noising by Weiner Filter (for Gaussian Noise)

MG GAUSMED-Figure (5): De-Noising by Median Filter (for Gaussian Noise)



MG SALTWIN-Figure (6): De-Noising by Wiener Filter (for Salt & Pepper Noise)



MG SALTMED-Figure (7): De-Noising by Median Filter (for Salt & Pepper Noise)

Conclusion

We used the original image (figure 1), adding two noise (Gaussian and salt & pepper) in original image (figure 2,3), De- noised all noisy images by the filters and conclude from the results figures (4,5,6,7)

a. The performance of the wiener filter after de- noising for Gaussian noise is better than median filter.

b. The performance of the median filter after de- noising for salt & pepper noise is better than wiener filter.

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