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Image Denoising Technique by using Various Filters

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Abstract: In this paper, two novel image filters are presented. These filters, named as Far Distance Filter (FDF) and Near Distance Filter (NDF), are actually based on calculating the distance between image pixels and their neighbours in order to construct arbitrary values used to enhance abnormal pixels (noise). FDF and NDF use (5 x 5) kernel instead of the usual (3 x 3) kernel to produce better image results. The performance of proposed filters and the well-known mean filters is investigated through the measurement of PSNR and MSE. This performance shows clearly the efficiency of the proposed filters.

Keywords: Image enhancement, noise removal, spatial filters, near distance filter, far distance filter

I. INTRODUCTION

In the recent years, image enhancement has become the interior of many important image processing and computer vision applications. Image enhancement involves taking an image and improving it visually, typically by taking advantage of the HVS (Human Visual System) response [5]. Sequences of enhancement techniques are widely used to facilitate the development of a solution for computer image problems. Many of these techniques require the use of low illumination or high magnification where problems associated with noise persist. For this reason, noise removal continues to be an important image processing task [4], Mean filters are the most commonly spatial filters used as a simple method for reducing noise in an image, particularly Gaussian noise. The idea of mean filtering is simply to replace each pixel value in an image with the mean 'average' value of its neighbours, including itself. The extracted average values are the result of the convolution process, which is commonly based on specified fixed convolution mask (kernel).Differently sized kernels containing different patterns of number achieving different results under Convolution. By increasing the size of the mean filter to 5 x 5, the obtained image will be characterized with less noise and less high frequency detail. In this paper, two new image enhancement filters have been developed; to remove and enhance the appearance of an image according to the distance measure between adjacent pixels. These filters are Far Distance Filter (FDF) and Near Distance Filter (NDF). Compared to the well-known mean filter, the proposed filters can achieve better results in Visual and quantitative measures.

II. FILTERS

Contrasting to the mean filter, the distance between the centralized pixel and its neighbours will be calculated to minimize the effectiveness of noisy pixels. The distance values represent the relation between good pixels and noisy pixels which satisfy the assumption that "far noisy pixels have less effect on surrounded good ones". From this assumption we are not going to give a static weight (distance value) to all pixels and treat them in same manner. Several methods can be applied to measure the distance between pixels. Here the image filtering method is using 2D filter matrix, and the 2D image for every pixel of the image, take the sum of products where the current pixel is obtained by colour value or a neighbour of it, with the corresponding value of the filter matrix. Filtering method that remove the unwanted noise from image .The centre of the filter matrix has to be multiplied with the current pixel and get the new value, the rest elements of the filter matrix with corresponding neighbour pixels [6].

III. MEDIAN FILTER

Median filter is a filtering technique that is non-linear by nature which changes the intensity value of image. Median filter is spatial filter, which change the variance of intensity of image. It is uses 2D filter to calculate the new pixel value of original image [5]. To apply the mask means to centre it in a pixel, calculating the brightness of pixel and determining which brightness value is the median value. There are number of steps to in median filter to calculate the new pixel value in processing image.

1. The neighbourhood pixels of the pixel in the original image which are calculated by the mask are stored in the ascending or descending order.
2. The median of the stored value is computed and is chosen as the pixel value for the processed image.

PSNR is most easily defined via the mean squared error (MSE). Given a noise free m×n monochrome image I and its noisy approximation K, MSE is defined as:

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

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The PSNR (in dB) is defined as:

$$PSNR = 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right)$$
$$= 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right)$$
$$= 20 \cdot \log_{10}(MAX_I) - 10 \cdot \log_{10}(MSE)$$

IV. EXPERIMENTAL RESULTS

In order to test the proposed NDF and FDF and well-known mean filters, a number of real life images were used using Matlab software package version 10.0. For all images, the Salt and Pepper noise type was added to produce noisy images. Peak Signal-to-Noise Ratio (PSNR) and Mean Square Error (MSE) are used as the evaluation criteria to measure the effectiveness of the proposed NDF, FDF and the well-known mean filters[9]. The phrase peak signal-to-noise ratio, often abbreviated PSNR, is an engineering term for the ratio between the maximum [6] possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.

The mean square error is equal to the square of the bias plus the variance of the estimator. If the sampling method and estimating procedure lead to an unbiased estimator, then the mean square error is simply the variance of the estimator. It is most easily defined via the mean squared error (MSE) which for two m×n monochrome images I and K where one of the images is considered a noisy approximation of the other.

The obtained PSNR and MSE measures are shown in Table 3 and Table 4 respectively. It can be observed from these tables that the NDF filter gives better results compared to the mean filter. In accordance with the visual quality assessment, the FDF produces images sharper than the ones produced by the mean filter [10].

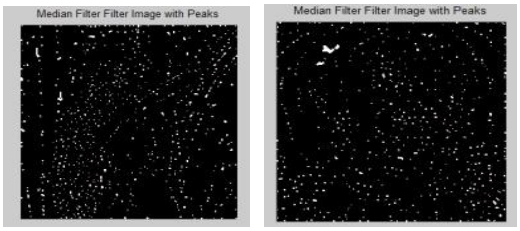

Fig 4.1 Median filter image with peaks

Fig 4.2 Median filter image

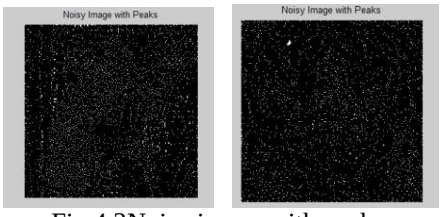

Fig 4.3Noisy image with peaks

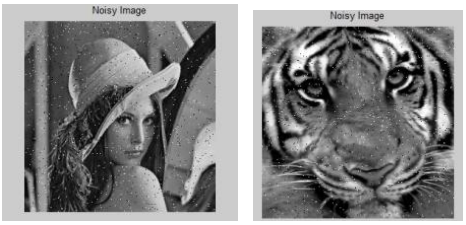

Fig 4.4 Noisy image

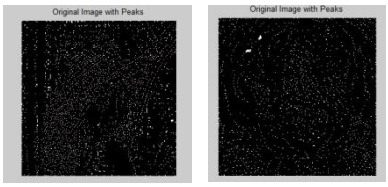

Fig 4.5Origninal image with peaks

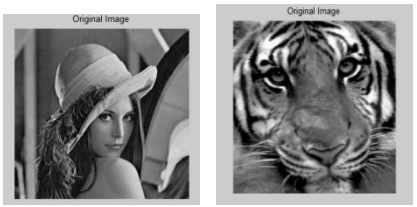

Fig 4.6 Origninal image

Fig 4.7 New filter image

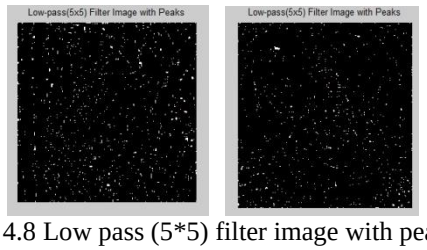

Fig 4.8 Low pass (5*5) filter image with peaks

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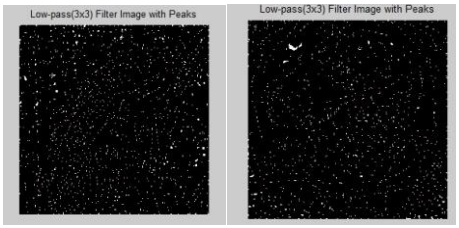

Fig 4.9 Low pass (3*3) filter image with peaks

Fig 4.10 Low pass (3*3) filter image Fig geometric mean filter image with peaks

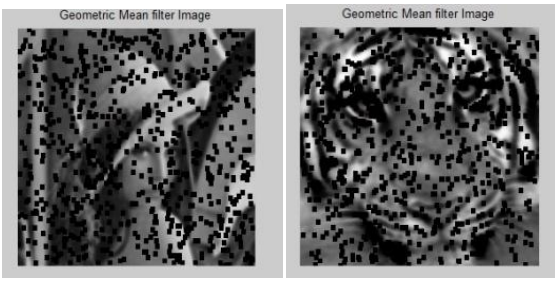

Fig 4.11 Geometric mean filter image

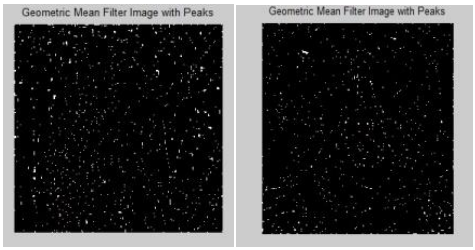

fig 4.12 Aeometic mean filter lmage with preaks

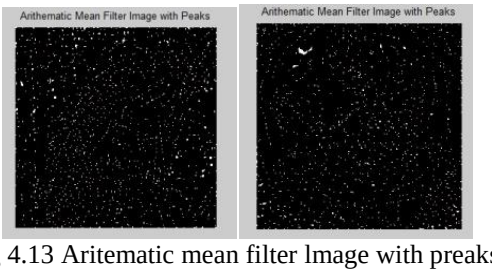

fig 4.13 Aritematic mean filter lmage with preaks

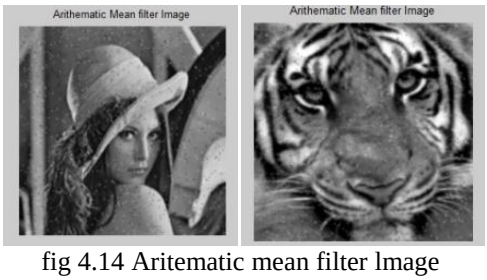

fig 4.14 Aritematic mean filter lmage

Table 1 Constructed PSNR and MSE results of Lena image

Filter	PSNR (dB)	MSE
LPF (3*3)	26.1833	0.0024
LPF (5*5)	24.6457	0.0034
Arithmetic mean filter	26.1833	0.0024
Median filter	25.8149	0.0026
Geometric mean Filter	22.2341	0.0060
New filter	27.1385	0.0019

Table 2 Constructed PSNR and MSE results of tiger image

Filter	PSNR (dB)	MSE
LPF (3*3)	26.6171	0.0022
LPF (5*5)	24.6630	0.0034
Arithmetic mean filter	26.6171	0.0022
Median filter	26.2170	0.0024
Geometric mean Filter	21.9042	0.0065
New filter	25.6886	0.0027

Table3 Constructed PSNR and MSE results of Lena image by applying NDF, FDF and mean filters

Filter	PSNR (dB)	MSE
NDF	+25.4291	0.0029
FDF	+23.5892	0.0044
Mean	+24.3693	0.0037

Table4 Constructed PSNR and MSE results of Tiger image by applying NDF, FDF and mean filter

Filter	PSNR (dB)	MSE
NDF	+25.5607	0.0028
FDF	+22.6949	0.0053
Mean	+23.6370	0.0043

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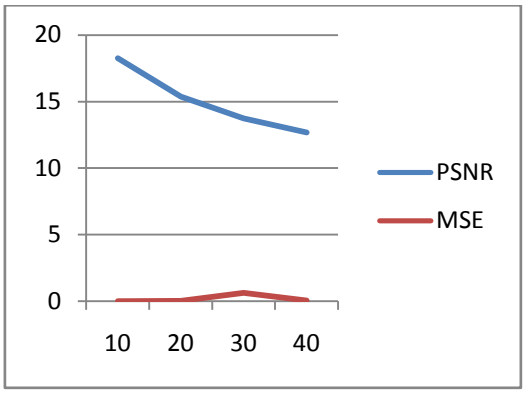

Fig 4.15 Noise Level (%)

Filter	10%		20%		30%		40%	
	PSNR	MSE	PSNR	MSE	PSNR	MSE	PSNR	MSE
LPF(3*3)	17.6744	0.0171	14.9577	0.0319	13.3685	0.0460	12.3397	0.0583
LPF(5*5)	17.1013	0.0195	14.4397	0.0360	12.8908	0.0514	11.8984	0.0646
Arithmetic mean	17.6744	0.0171	14.9577	0.0319	13.3685	0.0460	12.3397	0.0583
Median	16.8194	0.0208	13.8678	0.0410	12.1015	0.0616	10.9607	0.0820
Geometric	13.3900	0.0458	10.5230	0.0887	8.7292	0.1340	7.5386	0.1763
New	18.2517	0.0150	15.3774	0.0290	13.7296	0.0424	12.6716	0.0541

V CONCLUSIONS

Widely in image enhancement of the cardinality of (5 x 5) It is possible to improve these filters further by adding more criteria, such as threshold, or by expanding the filter kernel cardinality. This is left for future show in fig Image enhancement algorithms offer a wide variety of approaches for modifying images to achieve visually acceptable images. The choice of such techniques is a function of the specific task, image content, observer characteristics, and viewing conditions. The review of Image enhancement techniques using different filter have been successfully accomplished and is one of the most important and difficult component of digital image processing and the results for each method are also discussed. Based on the type of image and type of noise with which it is corrupted, a slight change in individual method or combination of any methods further improves visual quality. In this survey, we focus on survey the existing techniques of image enhancement,. We show the existing technique of image enhancement and discuss the advantages and disadvantages of these algorithms. Although we did not discuss the computational cost of enhancement algorithms it may play a critical role in choosing an algorithm for real-time applications.

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