Mixed Weighted Filter for Removing Gaussian and Impulse Noise

Gao Yinyu* · Nam-Ho Kim*

* Dept. of Control & Instrumentation Eng., Pukyong National Univ.

E-mail : nhk@pknu.ac.kr

ABSTRACT

The image signal is often affected by the existence of noise, noise can occur during image capture, transmission or processing phases. noises caused the degradation phenomenon and demage the original signal information. Many studies are being accomplished to restore those signals which corrupted by mixed noise. In this paper, we proposed mixed weighted filter for removing Gaussian and impulse noise. we first charge the noise type, then, Gaussian is removed by a weighted mean filter and impulse noise is removed by self-adaptive weighted median filter that can not only remove mixed noise but also preserve the details. And through the simulation, we compared with the conventional algorithms and indicated that proposed method significant improvement over many other existing algorithms and can preserve image details efficiently.

Keywords

Gaussian noise, Impulse noise, Noise type, Weighted filter, Details

Ⅰ. INTRODUCTION

Images can pick up noise from a variety of sources: during acquisition and transmission. Noise presence is exhibited by displeasing information that is not related to the scene under study. Noise reduction and elimination is the process of removing noise from a deteriorated image while keeping its features intact. It is one of the major concerns and fundamental operations in computer vision and image processing. For most typical applications, image noise can be adequately modeled with additive Gaussian noise and impulse noise and mixed noise. A large number of linear and nonlinear filtering algorithms have been developed to remove the mixed noise from corrupted images to enhance image quality. Among the linear filters, the important filters are average filter(AF), Gaussian filter(GF)[1][2]. These filters can efficiently remove Gaussian noise, but it ineffective in removing impulse noise, so this method not good enough to remove mixed noise. Various forms of nonlinear techniques have also been introduced to remove mixed noise. Among them, standard median(SM) filter seems to offer better performances in terms of preserving edge information and removing impulse noise[3]. However, one of the problems of the median filter destroys fine details, and produces streaks and blotches in restored images. Its variants, Z. Wang and D. Zhang proposed the progressive switching median(PSM) filter to improve performance[3]. However, these filters can remove impulse noise effectively, but they are ineffective to Gaussian noise[2][3].

In this paper, to remove mixed noise and preserve image details, we proposed an algorithm that first judges the type of the noise according to the difference values of pixel's neighborhood region and impulse noise's characteristic. Then Gaussian is removed by a weighted mean filter and impulse noise is removed by self-adaptive weighted median filter that can not only remove mixed noise but also preserve the details.

Ⅱ. PROPOSED METHOD

2.1. Noise Estimation

The estimation of noise point is accord to the difference values of pixel's neighborhood region. The image edge gray has continuity in one or several directions in the neighborhood region. But noise points gray are discontinuous in most directions. It means if a pixel is edge pixel, it has the maximum difference value between this pixel and neighborhood region pixels in one or several directions[3]. If a pixel is impulse noise point, where the impulse noise pixels can only have extreme values, it has the value of 0 or 255. if the difference (d) between the center pixel and other neighborhood region pixel is larger than threshold, at the same time, the number (N_n) which satisfies this situation is 0, the center pixel will be defined as Gaussian noise.

2.2. Noise Suppression Method

In order to preserve details, this paper proposes the method that uses complex algorithms. Then Gaussian is removed by a weighted mean filter and impulse noise is removed by self-adaptive weighted median filter that can not only remove mixed noise but also preserve the details.

A. Gaussian Noise Suppression

If the $N_n = 0$, the center pixel point is Gaussian noise point. Remove this noise by using following modified weighted mean filter. The weighted values change base on standard deviation (σ_m) of filtering mask. Near to the center pixel, the weight value is m_{k2}, and the pixel at diagonal, the weighted value is m_{k1}. m_{k3} is the weight gives to the center pixel.

1, If $\sigma_m > T_2$, the weighted values will be calculated as formula (1).

$$\begin{cases} m_{11} = \dfrac{T-6}{10\times(T-1)} \\ m_{12} = \dfrac{T+3}{10\times(T-1)} \\ m_{13} = 1-4\times(m_{11}+m_{12}) \end{cases} \quad (1)$$

2, If $\sigma_m \le T_2$, the weighted values to the differed regions are described as (2).

$$\begin{cases} m_{21} = \dfrac{1}{T+6} \\ m_{22} = \dfrac{3}{T+6} \\ m_{23} = 1-4\times(m_{21}-m_{22}) \end{cases} \quad (2)$$

The output after filtering is:

$$Y_g(i,j) = \sum_{p=-1}^{1}\sum_{q=-1}^{1} X(i+p,j+q)\times m_{kl}(i+p,j+q) \quad (3)$$

$$k=1,\,2;\;\; l=1,\,2$$

B. Impulse Noise Suppression

If the center pixel is valued 0 or 255, it is impulse noise. Then propose a adaptive weighted median filter to suppression the impulse noise. We first take the impulse noise out from the filtering mask, then those remained pixels defined as noise free pixels. We also compute out the median value from the noise free pixels, we define the median value as M.

The calculation process of the weighted values is described as follows:

$$V = \sum_{s=-N}^{N}\sum_{t=-N}^{N} \frac{1}{1+[X(i+s,j+t)-M]^2} \quad (4)$$

Here, M is the median value of the noise free pixels under the filtering mask W.

$$W = \{(s,t)\mid -N \le s \le N, -N \le t \le N\} \quad (5)$$

Here, (s,t) is the position of the pixels in the mask and the mask size is , and then SM filter chooses the median value in the mask.

$$w(i+s,j+t) = \frac{1}{(1+[X(i+s,j+t)-M]^2)\times V} \quad (6)$$

The output after filtering is:

$$Y_i(i,j) = \sum_{s=-N}^{N}\sum_{t=-N}^{N} X(i+s,j+t)\times w(i+s,j+t) \quad (7)$$

Ⅲ. EXPERIMENT RESULT ANALYZES

The proposed algorithm is tested using 512×512 standard images such as Lena(Gray). In addition to the visual quality, the performance is quantitatively measured by the peak signal to noise ratio(PSNR).

Fig.1 shows the simulation result of the Lena Image. In the Fig. 1, (a) is the original image; (b) is the noisy image that corrupted by impulse noise with the density of p=30% and AWGN with the standard deviation of . (c)~(f) show the restoration results of Lena image by AF(3×3) filter, SM(3×3) filter, PSM(3×3) and the proposed filter respectively.

Fig.1's simulation result shows that the proposed method has the best filtering effect compared with the traditional filter algorithms. The propo

Fig. 1. Simulation result.
(a) original image (b) noisy image (c) AF (3×3) (d) SM (3×3) (e) PSM (3×3) (f) proposed filter

sed method combines the good ability to get rid of mixed noise and rather good ability to protect the detail information.

Fig.2 compares the noise removal results by changing the impulse noise density. From Fig.2, the proposed method performs well and the PSNR values are higher than conventional algorithms.

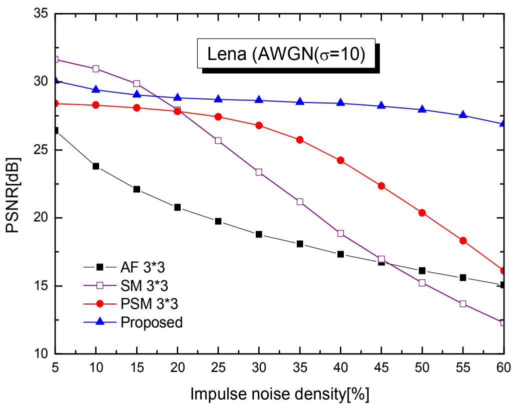

Fig. 2. PSNR for Lena image.

V. CONVOLUTIONS

In this paper, a new algorithm is proposed to remove mixed noise in the images. The proposed method first classifies the noise. And then removes the different noise by different filters. Through the computer simulation on test image, it indicates that the proposed method has good capability in mixed noise suppression. And this method is relatively a fast method and suitable to be implemented for consumer electronic products, such as digital camera.

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