A Fusion Approach to Eliminate Speckle Noise from Digital Images Using IVSA Algorithm

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ABSTRACT

Images are used to show proof or demonstration valuable information and it plays an vital role in research and technology. The main disadvantages of digital images are presence of blare and deprivation during their attainment or transmission. This paper presents a novel method of image restoration using Intensity Value Sharing Algorithm (IVSA).

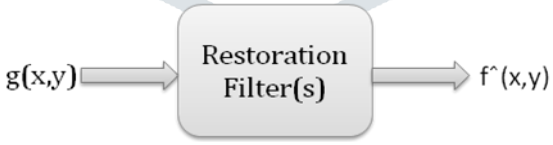
In this paper, the comparison of known image demising techniques is discussed and a new method, the sharing difference between pixels intensity based approach is proposed and used for the removal of impulse noise. Restoration methods can primarily preserve image details while suppressing impulsive noise. The principle of these methods is introduced and analyzed with different simulation results using MATLAB. Most of the prior known techniques are applicable for the demising of images degraded with less noise density. Here a new algorithm is presented which is better than the existing algorithms. Performances of the techniques are compared with the parameters MSE, PSNR and SSIM.

Keywords- *Degradation, Noise, Restoration, De-noising, PSNR, MSE, SSIM*

I. INTRODUCTION

Digital Image Processing is mainly concerned with improvement of pictorial information for human understanding and processing of image data for storage, communication and representation. There are different techniques that are developed to support variety of image processing applications. Digital Image Processing has numerous applications in various studies and researches in science and technology. Some of the fields that utilize Digital Image Processing include astronomy, finger print, medical fields and photography. Image restoration is one of the active fields in Digital Image Processing. Image restoration from corrupted image is a classical problem in the field of image processing.

The field of image restoration (sometimes referred to as image de-noising or image de-convolution) is concerned with the reconstruction or estimation of the uncorrupted image from a blurred and noisy image [1].



A model of Image Restoration

Here g(x,y) is the degraded image and $\hat{f}$ (x,y) is restored image.

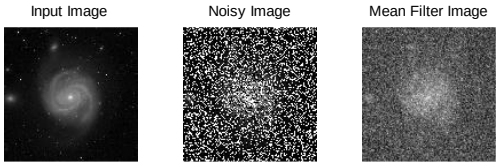
The detection and removal of the noise play a crucial role in restoration. Estimating the noise level from a single image is an impossible task, and hence we need to recognize whether local image variations are due to the color, texture, or lighting variations from the image itself or due to the noise. Image restoration increases the quality of the image by removing of noisy pixels. The restoration of a degraded image can be done by algorithm, which identifies noisy pixel in the entire image [2].

II. REVIEW OF DENOISING FILTERS

Noise filtering methods can either be linear or non-linear. Linear filters have a tendency to blur sharp edges, demolish lines and other fine details of image. The non-linear filtering method is a two stage filtering process. In the first stage, the pixels are identified as affected or unaffected pixel and in the second stage the affected pixel is filtered using the specified algorithm and the unaffected pixel value is retained.

a. Mean Filter (MF):

The Mean filter is a linear filtering method, often used to remove noise. It simply smoothens local deviation in an image.



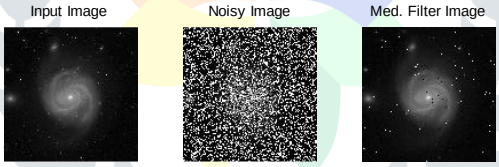
Restoration by Mean filter

The Mean filtering techniques are applied linearly to all the pixels in the image without defining the image as affected or unaffected pixel. Since these algorithms are applied to the entire pixels in the image, the uncorrupted pixels are also filtered and hence these filtering techniques are not effective in removing impulsive noises.

b. Standard Median Filter (SMF):

The most commonly used non-linear filter is the median filter which uses the median value to substitute the corrupted pixel, and these filters have the capability to remove impulsive noise while preserving the edges. It is also called order-statistics filter. The main idea of the median filter is to run through the signal entry by entry, replacing each entry with the median of neighboring entries.

The median filter expression is, $$f(x,y) = \underset{(s,t)\in S_{xy}}{median}\{g(s,t)\}$$



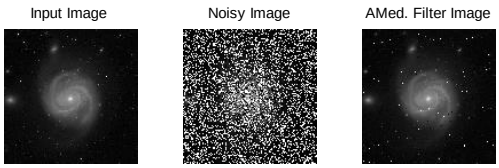
Restoration by Median filter

A major advantage of the median filter over linear filters is that the median filter can eliminate the effect of input noise values with extremely large magnitudes. In this method, a square window of size 2k+1, where k goes from 1 to N, is used to filter the center pixel. The pixels in the window are first sorted and the center pixel is changed to the median value of the sorted sequence. This method is the simplest of the median filtering techniques and because of its simplicity.

c. Adaptive Median Filter (AMF):

The adaptive median filter also applies the noise detection and filtering algorithms to remove impulsive noise. The size of the window applied to filter the image pixels is adaptive in nature, i.e. the window size is increased if the specified condition is not met. If the condition is met, the pixel is filtered using the median of the window.

Let I_{ij} be the pixel of the corrupted image, I_{min} be the minimum pixel value and I_{max} be the maximum pixel value in the window, W be the current window size applied, W_{max} be the maximum window size that can be reached and I_{med} be the median of the window assigned. Adaptive median filters are widely used in filtering image that has been denoised with noise thickness greater than 20%.



Restoration by Adaptive Median filter

III. PROPOSED METHOD - IVSA

Restoration methods are basically mathematical modeling of degradation and applying inverse process to restore the original image. In the proposed method, Intensity Value Sharing Algorithm (IVSA) is implemented to restore the image. The algorithm has two phases.

a. Phase-I:

Phase I processes the first column of noisy image pixels by looking at the pixel value to decide whether the pixel is corrupted or not. If the pixel value lies between the minimum (0) and the maximum (255) the pixel is left unchanged (as it is detected as a noise free pixel), otherwise the pixel is replaced with the nearest uncorrupted pixel value.

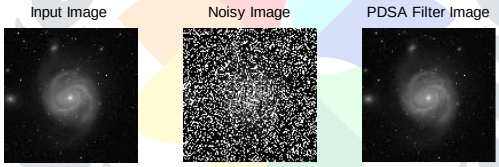
b. Phase-II:

In this phase, Intensity Value Sharing Algorithm (IVSA) is really implemented. Here the algorithm is implemented by row wise. It starts with second pixel ($I_{i,j+1}$) of first row and initialize the counter to zero. If it is noise free pixel, then it moves to next pixel ($I_{i,j+2}$) otherwise increases the counter and makes the next move. The above action is repeated until uncorrupted pixel is found out.

Now counter has the number of corrupted pixels between two noise free pixels. These two pixels are called left and right pixels. The difference between the left and right noise free pixels is calculated and this difference is divided by the counter value. This result is exact pixel difference value that lays between left and right noise free pixels.

Then the iteration starts from the exact next position of the left pixel and it ends with exact previous position of right pixel. If the left pixel value is smaller than right pixel value then the exact difference is added with left pixel value otherwise the value is subtracted from left pixel value and stored in the first position of the iteration and counter value is decreased.

The action repeats until the value is stored in all the positions of iteration and the counter becomes zero. The above operation continues until all the pixels of the degraded image are tested.



Restoration by IVSA filter

Restored images are compared on the basis of performance parameters like MSE, PSNR and SSIM.

IV. PERFORMANCE EVALUATION

The above restoration methods are evaluated using the quality measures like Mean Square Error (MSE), Peak Signal to Noise ratio (PSNR) and Structural Similarity Index Metric (SSIM).

The MSE, PSNR are calculated, it is to be noted that greater the value of PSNR and lower the value of MSE, the filtering technique is better. These results are presented in a tabular form in Table I and Table II.

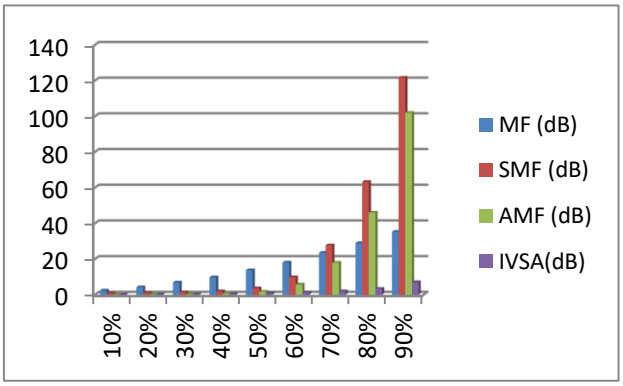
Similarly the SSIM values are obtained and the results are presented in Table III.

MSE, PSNR, SSIM VALUES FOR LENA IMAGE OF SIZE 512X512 AT DIFFERENT NOISE DENSITIES

TABLE I

Noise Density	MF (dB)	SMF (dB)	AMF (dB)	IVSA (dB)
10%	2.39	0.82	0.14	**0.07**
20%	4.25	1.07	0.23	**0.17**
30%	6.88	1.35	0.37	**0.31**
40%	9.82	1.94	0.67	**0.50**
50%	13.79	3.66	1.73	**0.81**
60%	18.08	9.87	5.80	**1.21**
70%	23.56	27.70	17.96	**1.94**
80%	28.98	63.25	46.06	**3.34**
90%	35.31	121.63	101.97	**7.10**

MSE Values for Lena Image of Size 512x512 At Different Noise Densities

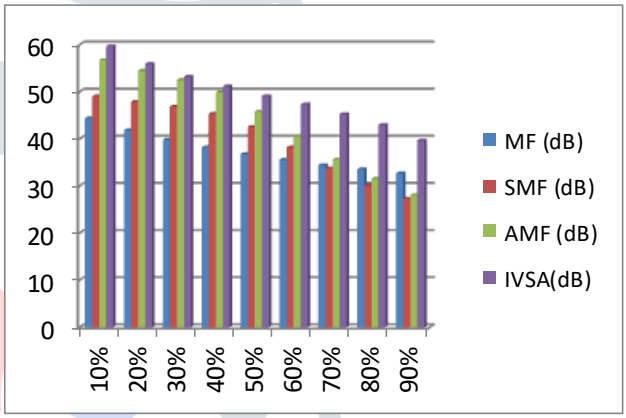


Histogram of MSE values

TABLE II

Noise Density	MF (dB)	SMF (dB)	AMF (dB)	IVSA(dB)
10%	44.39	49.04	56.73	**59.69**
20%	41.88	47.88	54.49	**55.91**
30%	39.79	46.86	52.54	**53.21**
40%	38.24	45.30	49.90	**51.14**
50%	36.77	42.53	45.79	**49.09**
60%	35.59	38.22	40.53	**47.33**
70%	34.44	33.74	35.62	**45.28**
80%	33.54	30.15	31.53	**42.93**
90%	32.69	27.31	28.08	**39.65**

PSNR values for Lena image of size 512x512 at different noise densities

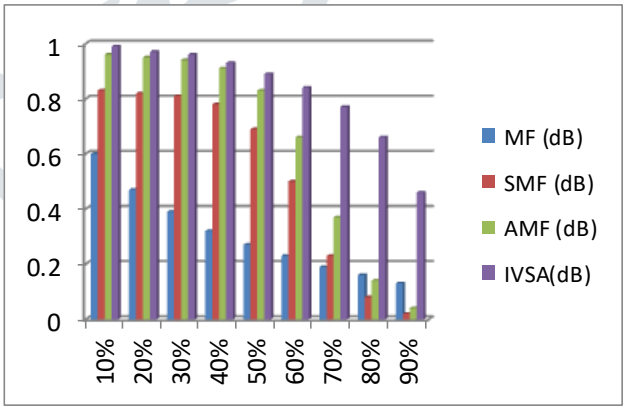


Histogram of PSNR values

TABLE III

Noise Density	MF (dB)	SMF (dB)	AMF (dB)	IVSA(dB)
10%	0.60	0.83	0.96	**0.99**
20%	0.47	0.82	0.95	**0.97**
30%	0.39	0.81	0.94	**0.96**
40%	0.32	0.78	0.91	**0.93**
50%	0.27	0.69	0.83	**0.89**
60%	0.23	0.50	0.66	**0.84**
70%	0.19	0.23	0.37	**0.77**
80%	0.16	0.08	0.14	**0.66**
90%	0.13	0.02	0.04	**0.46**

SSIM values for Lena image of size 512x512 at different noise densities



Histogram of SSIM values

The results presented in the tables and figures are suggest that pixel difference sharing algorithm (IVSA) performs better than other techniques.

V. CONCLUSION AND FUTURE SCOPE

In this paper, different filtering techniques have been discussed and the new algorithm proposed produces better results compared to the better techniques available. Noisy image is restored by using mean filter (MF), standard median filter (SMF) and adaptive median filter (AMF) techniques. Restored images are compared on the basis of performance parameters like MSE, PSNR and SSIM.

The results based on adaptive median filter (AMF) provided better results than other two filtering techniques. But the proposed method Intensity Value Sharing Algorithm (IVSA) gives good visual clarity and better results than adaptive median filter (AMF) while de-noising impulsive noise for all noise densities. In future, if the noise densities are considerably higher, then the new algorithms can be developed to get much better results than the techniques described.

REFERENCES

[1] Gonzalez R.C., Woods R.E. and Steven L.E., "*Digital Image processing using MATLAB"*, Dorling Kindersley (India) Pvt. Ltd., 2007.

[2] Anji Reddy M., Hari Shankar Y., "*Digital Image Processing*", BS Publications, 2009.

[3] Medhavi Aggarwal, Ranjit Kaur and Beant Kaur, "*A Review of De-noising Filters in Image Restoration*", International Journal of Current Research and Academic Review, ISSN: 2347-3215, Volume 2, Number 3, (2014), pp. 83-89.

[4] E.Jebamalar Leavline and D.Asir Antony Gnana Singh, "*Salt and Pepper Noise Detection and Removal in Gray Scale Images: An Experimental Analysis*", International Journal of Signal Processing, Image Processing and Pattern Recognition, Vol.6, No.5, pp.343-352, 2013.

[5] Hani M. Ibrahem, "*An Efficient and simple switching filter for removal of high density salt and pepper noise*", International Journal of Image Graphics and signal processing, published online October 2013, Vol. 12, pp.1-8 in MECS.

[6] Xudong Jiang, "*Iterative Truncated Arithmetic Mean Filter and Its Properties*", IEEE Transactions on Image Processing, Vol. 21, No. 4, April 2012.

[7] Trapti Soni and Narendra Rathor, "*Removal of High Density Impulse Noise using Efficient Median filter for Digital Image*", International Journal of Computer Applications, Vol. 15, No.5, 2015.

[8] Suman and Shrestha, "*Image Denoising using New Adaptive Based Median Filter*", Signal & Image Processing: An International Journal (SIPIJ) Vol.5, No.4, August 2014.

[9] Poorna Banerjee Dasgupta, "*Analytical Comparison of Noise Reduction Filters for Image Restoration Using SNR Estimation*", International Journal of Computer Trends and Technology (IJCTT) – Vol. 17, No. 3 – November 2014.

[10] Yusra A.Y, Der Chen Soong, "*Comparison of Image Quality Assessment: PSNR, HVS, SSIM, UIQI*", International Journal of Scientific & Engineering Research, ISSN 2229-5518, Volume 3, Issue 8, August 2012.

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