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Self Organizing Migration with Adaptive Dual Threshold Median Filter For the Removal of RVIN From Highly Corrupted Images

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***Abstract*— Impulse Detection is very crucial and important in random valued impulse noise (RVIN) and it is difficult to remove with high density. This noise does not obstruct the image pixels regularly. This paper presents a new approach of self organizing migration (SOM) with adaptive dual threshold median filter (ADTMF) for restoring the original image with image quality. In this study, apply this algorithm on different window size and varying noise density. In the SOM approach, find the optimal solution (type of wavelet, level of decomposition and varied threshold value) for denoising. SOMA obtains better quality with the help of varying threshold on the basis of image pixels. The threshold can be determined using ADTMF algorithm. This algorithm can easily remove highly corrupted images in a limited amount of time.For noise free image evaluation using various parameters for example Peak Signal Noise Ratio (PSNR). It is shown that the improved method gives a high degree of noise removal while preserving the edges and other information in the image. The proposed threshold computation is based on average of image pixels on window size which improves the PSNR of the system as compared to previous ADTMF and other median based filters.**

Keywords*— *SOMA, RVIN, ADTMF, PSNR, Image Denoising

I. Introduction

Digital image play principal position each in day-to-day existence functions like satellite television as, pc tomography good as in research and technological data areas for instance geographical astronomy and knowledge systems [1]. At the time of transmission and acquisition, images are often corrupted through the noise. Denoising is therefore the common issue in application of image processing. The denoising purpose is then to decrease level of noise, while image features preserving like stextures and edges and so on as accurately as possible [2].

To remove noise in the image domain, image matching is used in the spatial filtering method or the frequency filtering method. These filtering methods can quickly and exactly remove noise. However, the shape-based image matching considering the partial noise incurs heavy computation overhead because of finding and removing the partial noise in a boundary image [3].

Since the human visual system is highly sensitive to textures and edges, geometric or directional wavelets for image denoising have become a famous subject in the last few years. Compared with wavelet, multidirectional wavelets (such as, contourlet, curvelet, directionlet, or bandelet) can provide a good sparsity for spatially localized details. Thus, multidirectional-wavelet-based denoising approaches can create an improved visual feature for highly structured image patterns [4].

Most filters could not preserve image textures and edge as well as possible. Although most of the filters use several quality evaluation metrics and PSNR for estimating the filter's performance, there are additional assessments like visual assessment through analysis of texture and expertise that could be investigated [5].

In this paper for noise removal using techniques are Progressive Switching Median Filter Method, Median Filter Method, Adaptive Dual Threshold Median Filter Method and SOM which is studied in section 2.

II. Noise Model

The impulse noise model comprises only two impulse values with equal probability. These are the minimum and maximum pixel values of the considered integer interval (i.e., 0 and 255 for an 8-bit image). The minimum pixel value, i.e., a black pixel is called negative impulse or salt and the maximum pixel value, i.e., a white pixel is called positive impulse or pepper [6].

In RVIN noise is spread consistently. Dynamic range [0, 255] may take by RVIN. Before introducing the proposed framework, we first define the two most commonly used impulse noise models used in this paper.

A. Impulse Detection

Same as other impulse detection algorithms, impulse detector is developed through a *prior* natural images based information, i.e., a noise-free image should be locally smoothly varying, and is separated through edges.:

1) Every image pixels proportion is corrupted while other pixels are noise-free.

2) A noise pixel take either a very large and a very small value as an impulse which is positive or negative.

B. Noise Filtering

Like the impulse detection procedure, the noise filtering procedure also generates a grayscale image sequence, $\{\{y_i^{(0)}\},\{y_i^{(1)}\}.\{y_i^{(2)}\}\ldots\ldots\ldots\ldots\{y_i^{(n)}\}\ldots.\}$,and a binary flag image sequence$\{\{g_i^{(0)}\},\{g_i^{(1)}\}.\{g_i^{(2)}\}\ldots\ldots\ldots\ldots\{g_i^{(n)}\}\ldots.\}$,In sequence of gray scale image, here $y_i^{(0)}$use to represent the pixel value at 2nd position in noisy image to be filtered and use$y_i^{(n)}$to represent the 2nd position pixel value in the image after the nth iteration. In a binary flag image $\{g_i^{(0)}\}$the value $g_i^{(n)}$= 0 means the pixel ii is good and $g_i^{(n)}$= 1 means it is an impulse that should be filtered [8].

III. FILTER METHOD

3.1. Progressive Switching Median Filter Method

A novel median-based switching filter, known as progressive switching median (PSM) filter, where both noise filter and impulse detector are using progressively in the iterative manners. A main benefit of such a technique is that some impulse pixels located in large noise blotches middle can also be correctly detected and filtered.

3.2. Median Filter Method

Median value is the value in the middle position of any sorted sequence [12]. Image de-noising approach based some median filter have been proposed, some median filter are application oriented. Some of the significant methods have been explained below.

3.3. Adaptive Dual Threshold Median Filter Method (ADTMF)

De-noising method is a method based on median filter with adaptive dual threshold. In single threshold system, when central pixel is checked for the presence of noise, any pixel value lesser than (or greater than) the given single threshold will be considered as noise. In this system, the pixel values range used for noisy pixels recognizing will be large. This may increase the possibility of incorrect detection. [9]

3.4. SOMA

SOMA, an evolutionary algorithm, was proposed in 2000 by Zelinka. The methodology of SOMA is derived from the social behavior of animals while rummaging for food. If one of the animals in a pack finds a food source, others follow him to get to the site. Thus the former becomes a leader. A similar process is used by SOMA, where in a population of individuals (solutions in a search space) is characterized by their position. Based on the fitness (similar to closeness to food), of each individual one of them assumes the position of a leader and others follow the leader by updating their position. [14-15]

3.5. Stein's Unbiased risk Estimator

Wavelet is a Multi-resolution Analysis (MRA) process eliminating data capable from an image (or a signal) space-frequency resolutions varying. If achieve a noisy image wavelet decomposition, because of wavelet representation sparsity, signal component is classically concentrated in a few high amplitude coefficients while noise is spread uniformly across all coefficients. This forms the basis of wavelet shrinkage denoising. If we decrease to zero wavelet coefficients having amplitude less than a chosen threshold value, most of the noise would be eliminated from the image.

The main steps of wavelet shrinkage are:

1. Computing Discrete Wavelet Transform (DWT) of the original image

2. Thresholding of wavelet coefficients.

3. Performing Inverse DWT(IDWT)

IV. PROBLEM DEFINITION AND OBJECTIVE OF PROPOSED WORK

In previous median filter based method has many issues for removing high density noisy pixels. ADTMF method removes noise on low density, but for the high density noise it did not work properly. And quality measures did not achieve good results in terms of PSNR and image quality. For resolving these factors, suggest an evolutionary algorithm with an ADTMF method for improving previous results. This proposed algorithm determined optimal set of parameters and refine the results. But the sometime previous approach gives better result as compared to proposed because of learning algorithm. It detects noise on small window size easily with high density noise.

V. PROPOSED METHODOLOGY

In the proposed system, present hybrid method of SOM and ADTMF, the noisy pixels are finding in a relatively narrow range and thus can reduce the probability of incorrect detection. In the proposed method, the image to be denoised is partitioned into sub-images (filtering windows). For any given N X N gray level image which is defined by $f: N \times N \rightarrow I$ where I = [a, b] represents the range of pixel values. Pixel value at location (i, j) is given by f(i, j).

Let r X r be size of the filtering window ''W'', formed by partitioning of an image. In the process of denoising requires selection of the type of wavelet basis function (mother wavelet) to be used, the level of decomposition and the threshold value for each level of decomposition. In this paper, we employ SOMA to find an optimal value for below variables. To find the optimal solution, we take threshold on the ADTMF method basis.

Average values of a set of samples (data values) always lie in close proximity to the values under consideration. Averages of rows and columns of filtering window are used for threshold computation in proposed method which leads to efficient noise detection. In each filtering window, Th_{min} (minimum threshold) and Th_{max}(maximum threshold) are estimated which are used to abrupt changes detect in pixel values.

The parameters that govern the convergence and performance SOMA behavior are: [10]

- Various individuals and their dimension
- Various iterations (migration loops)
- Path Length: It governs the position at which an individual will stop while following the leader. A value greater than 1 is chosen to intensify exploration.
- Step Size: It decides the granularity of the path towards the leader.
- PRT: Pattern created applying this variable directs the

TABLE I. SET VARIABLES FOR OPTIMIZATION

Variables to be optimized	**Permitted Values**
Types of Wavelet	Daubechies (db4, db6, db8), Symlet (sym4, sym6, sym8, sym10), Coiflet (coif2, coif4)
Decomposition Level	1-4
Threshold	It is estimated using ADTMF

1. Illustrations

Illustration: Case1

STEP-1: A filtering window is selected

Central pixel (cp)

Selected filtering window

$$\begin{pmatrix} 121 & 0 & 255 & 233 & 121 & 255 \\ 255 & 129 & 0 & 138 & 235 & 243 \\ 0 & 253 & 142 & 255 & 0 & 255 \\ 255 & 136 & 132 & 255 & 255 & 0 \\ 0 & 255 & 129 & 136 & 0 & 255 \end{pmatrix}$$

STEP-2: Now dual threshold values are computed for noise detection

Talking average of each column

$$\begin{pmatrix} 121 & 0 & 255 \\ 255 & 255 & 0 \\ 0 & 253 & 142 \end{pmatrix}$$

C1=125,C2=169, C3=132

Talking average of each row

$$\begin{pmatrix} 121 & 0 & 255 \\ 255 & 255 & 0 \\ 0 & 253 & 142 \end{pmatrix}$$

R1=125,R2=169, R3=132

STEP-3: Existence of noise is checked by comparing the Central Pixel (CP) with thresholds

STEP-4: Here value of CP lies in between the two different thresholds, the CP is considered to be noise free and remains unchanged

Illustration: Case2

STEP-1: A filtering window is selected

Central pixel (cp)

Selected filtering window

$$\begin{pmatrix} 121 & 0 & 255 & 233 & 121 & 255 \\ 255 & 255 & 0 & 138 & 235 & 243 \\ 0 & 253 & 142 & 255 & 0 & 255 \\ 255 & 136 & 132 & 255 & 255 & 0 \\ 0 & 255 & 129 & 136 & 0 & 255 \end{pmatrix}$$

STEP-2: Now dual threshold values are computed for noise detection

Talking average of each column

$$\begin{pmatrix} 121 & 0 & 255 \\ 255 & 255 & 0 \\ 0 & 253 & 142 \end{pmatrix}$$

C1=125,C2=169, C3=132

Talking average of each row

$$\begin{pmatrix} 121 & 0 & 255 \\ 255 & 255 & 0 \\ 0 & 253 & 142 \end{pmatrix}$$

R1=125,R2=169, R3=132

STEP-3: In this step, existence of noise is checked by comparing the CP with thresholds

STEP-4: Since the CP value is not lying in between the two thresholds, the central pixel (CP) is considered to be noisy STEP-5: Since the CP is noisy, it will be replaced by median value of filtered window i.e. 142

Proposed Algorithm

1. Consider 'I (x)' as the intensity value of image.
2. Add RVIN pixels into input image, I at pixel location x and [d_{max},d_{min}] the dynamic range of I. Dynamic range of image gray levels. For 8-bit images, d_{max} = 0 and d_{min} = 255. [7]

$$I_{noisy}\,(x) = \begin{cases} d_x & with\, probability\; r \\ I(X) & with\, probability\; (r-1) \end{cases} \quad (1)$$

Here d_x is uniformly distributed in [d_{max},d_{min}]and r defines the random-valued impulse noise level [11].

3. Consider that the gray levels of any pixel value, in any window (w_x) of size n Xn are represented by $X_1, X_2, X_3, X_4, \ldots \ldots \ldots \ldots X_1$and it becomes $X_{i1} \geq X_{i2} \geq X_{i3} \geq \cdots \ldots \ldots . X_{in}$ after sorting it in descending or in an ascending order

$$M_X = Median\;(W_X) = \begin{cases} X_{i(n+1)/2;} & n\; is\; odd \\ \frac{1}{2}\left[X_{i\left(\frac{n}{2}\right)} + X_{i\left(\frac{n}{2}\right)+1}\right]; & n\; is\; even \end{cases} \quad (2)$$

4. A generalized filtering window ''W'', is given in Eq. (3), it has rxr matrix. The gray level at any pixel (i,j) is represented by $X_{(i,j)}$

$$w = \begin{bmatrix} x_{1,1} & x_{\left(1,\frac{r+1}{2}\right)} & x_{1,r} \\ x_{\left(\frac{r+1}{2},1\right)} & x_{\left(\frac{r+1}{2},\frac{r+1}{2}\right)} & x_{\left(\frac{r+1}{2},r\right)} \\ x_{r,1} & x_{\left(r,\frac{r+1}{2}\right)} & x_{r,r} \end{bmatrix} \quad (3)$$

5. In order to estimation thresholds, first of all, the elements averages in individual rows ($A_v(R)$) of filtering window are calculated.

$$A_v(R_r) = \frac{1}{r}\sum_{j=1}^{r} X(r,j) \quad (4)$$

6. This process will result ''r'' average values corresponding to every row. After that the averages of elements in individual columns ($A_v(C)$) of filtering window are calculated.

$$A_v(C_r) = \frac{1}{r}\sum_{i=1}^{r} X(i,r) \quad (5)$$

7. This process will also result ''r'' average values corresponding to every column. These ''2r'', distinct average values will be used for finding Th_{min} and Th_{max} using following equations:

$$Th_{min} = min\{A_v(R_1), \ldots A_v(R_r), A_v(C_1), \ldots A_v(C_r)\} \quad (6)$$

$$Th_{max} = max\{A_v(R_1), \ldots A_v(R_r), A_v(C_1), \ldots A_v(C_r)\} \quad (7)$$

8. Now, the noise corruption at CP of filtering window is checked by comparing it with Th_{max} and Th_{min}. If CP value lies between thresholds computed by Eqs. (6) And (7), then it is considered as noise free otherwise noisy.

$$CP = \begin{cases} Th_{min} < CP < Th_{max}; & Noisefree \\ Else; & Noisy \end{cases} \quad (8)$$

If the CP is estimated as noisy, then the noise removal is need to be applied at specific CP, otherwise it is kept same and filtering window is shifted to the next pixel. At noise elimination stage, simple median (M) of the filtering window has been used to change the gray level of the detected noisy pixel.

$$\delta = \min(t, \sigma\sqrt{2 \times \log(no. of\; pixels)})$$

Where, δ is estimated threshold, t is the threshold which is estimated using ADTMF method that minimizes Stein's unbiased risk estimator and σ is the standard deviation of noise, which is estimated as follows (x being wavelet detail coefficients at 4[th]decomposition level). [13]

9. Initialize the population and compute each individual fitness
10. Select leader (individual with highest fitness)
11. Create PRT vector with the help of equation (9)

$$PRT_{vec}(i) = 1; if\ r\ and < PRT\ for\ each\ dimension \qquad (9)$$

12. Update the position of individuals using equation (10)

$$x_p^{l+1} \leftarrow x_p^1 + \left(x_{leader}^{l+1} - x_{p,start}^{l+1}\right) \times step\ \_\ size \times prtvec\ (10)$$

13. Update fitness value and select new leader

Repeat steps 11 to 14 till a termination criterion is satisfied

VI. Comparative Tables

The experimental outcomes have been implemented using MATLAB12 on Image Processing . The results have been tested on gray scale with different types of format images of size 256 X256. The evaluation of the proposed method is obtained on the basis of PSNR. We have implemented image denoising on various images corrupted with RVIN noise on different noise density. It is varying from 10% to 70%. The denoised images are evaluated using three criteria mentioned below:For the de-noised image ‘‘Z’’, of size M X N, the PSNR is given by:

A. *Peak Signal Noise Ratio:* PSNR is used to measure the visual quality of the denoised image in comparison to the original image. Calculate PSNR and Mean Square Error (MSE) value of a denoised and original image.

$$MSE(x) = \frac{1}{N}||x - x^{\wedge}||^2 = \frac{1}{N}\sum_{i=1}^{N}(x - x^{\wedge})^2 \qquad (11)$$

Where x is the original image, x^ is denoised image, N is original image size

$$PSNR(x) = \frac{10\ X\log((double\ (m).\wedge 2))}{MSE\,(x)} \qquad (12)$$

Giving original image x and a denoised image x′, N is cover image size, m is the original image maximum value.

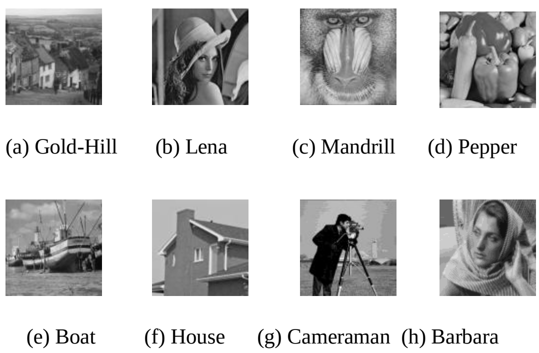


Fig. 1. Original grayscale test images of 8-bit per pixel.

TABLE II. PSNR (dB) VALUES OF DIFFERENT FILTERS FOR GOLD-HILL IMAGE DEGRADED BY RVIN.

Method	10%	20%	30%	40%	50%	60%	70%
MED[12]	30.21	28.23	25.60	22.90	20.42	17.98	16.12
PSMF	32.06	29.09	26.20	23.50	21.18	18.50	16.52
ADTMF	29.65	28.64	26.78	24.78	22.68	19.85	17.66
Proposed	**38.45**	**38.53**	**37.47**	**38.08**	**38.43**	**38.06**	**38.16**

TABLE III. PSNR (dB) VALUES OF DIFFERENT FILTERS FOR LENA IMAGE DEGRADED BY RVIN.

Method	10%	20%	30%	40%	50%	60%	70%
MED	29.58	27.51	24.89	21.93	19.29	16.91	14.71
PSMF	30.80	28.30	25.52	22.69	20.05	17.49	15.05
ADTMF	29.06	27.88	26.29	23.95	21.44	18.70	15.98
Proposed	**38.75**	**38.73**	**39.17**	**38.51**	**39.28**	**38.98**	**40.22**

TABLE IV. PSNR (dB) VALUES OF DIFFERENT FILTERS FOR MANDRILL IMAGE DEGRADED BY RVIN.

Method	10%	20%	30%	40%	50%	60%	70%
MED	24.24	23.53	22.51	21.24	19.58	17.82	24.27
PSMF	25.79	24.72	23.45	21.98	20.18	18.28	25.78
ADTMF	23.98	23.55	22.95	22.12	20.93	19.32	24.01
Proposed	**36.17**	**37.09**	**36.89**	**36.82**	**36.84**	**36.03**	**36.54**

TABLE V. PSNR (dB) VALUES OF DIFFERENT FILTERS FOR PEPPER IMAGE DEGRADED BY RVIN.

Method	10%	20%	30%	40%	50%	60%	70%
MED	31.95	29.12	25.88	22.63	20.32	17.87	15.85
PSMF	32.34	28.98	26.08	23.01	20.83	18.38	16.13
ADTMF	31.16	29.43	27.34	24.71	22.44	19.80	17.31
Proposed	**38.86**	**39.09**	**39.40**	**39.04**	**39.58**	**39.07**	**40.22**

TABLE VI. PSNR (dB) VALUES OF DIFFERENT FILTERS FOR BOAT IMAGE DEGRADED BY RVIN.

Method	10%	20%	30%	40%	50%	60%	70%
MED	28.21	26.99	24.80	22.43	20.45	18.48	16.43
PSMF	29.37	27.57	25.20	22.86	20.92	18.80	16.64
ADTMF	27.49	26.81	25.47	23.86	22.16	20.15	17.87
Proposed	**38.08**	**37.73**	**40.13**	**39.98**	**39.49**	**38.46**	**37.94**

TABLE VII. PSNR (dB) VALUES OF DIFFERENT FILTERS FOR HOUSE IMAGE DEGRADED BY RVIN.

Method	10%	20%	30%	40%	50%	60%	70%
MED	32.27	29.45	26.62	23.54	21.05	18.71	16.69
PSMF	33.42	29.75	26.68	24.07	21.52	19.18	17.05
ADTMF	32.26	30.02	27.81	25.97	23.42	20.86	18.44
Proposed	**39.74**	**39.85**	**39.80**	**39.27**	**39.48**	**39.46**	**39.28**

TABLE VIII. PSNR (dB) VALUES OF DIFFERENT FILTERS FOR CAMERAMAN IMAGE DEGRADED BY RVIN.

Method	10%	20%	30%	40%	50%	60%	70%
MED	27.98	26.05	23.65	20.99	18.66	16.33	14.47
PSMF	28.75	26.18	24.08	21.50	19.26	16.74	14.69
ADTMF	27.39	26.15	24.90	22.78	20.42	17.81	15.61
Proposed	**40.43**	**39.37**	**39.59**	**40.21**	**39.27**	**39.86**	**38.96**

TABLE IX. PSNR (DB)VALUES OF DIFFERENT FILTERS FOR BARBARA IMAGE DEGRADED BY RVIN.

Method	10%	20%	30%	40%	50%	60%	70%
MED	26.22	25.07	23.48	21.73	19.73	17.79	15.96
PSMF	27.00	25.49	23.83	22.07	20.17	18.27	16.29
ADTMF	25.19	24.52	23.71	22.68	21.22	19.42	17.38
Proposed	**38.53**	**38.24**	**37.67**	**38.53**	**39.12**	**39.52**	**38.04**

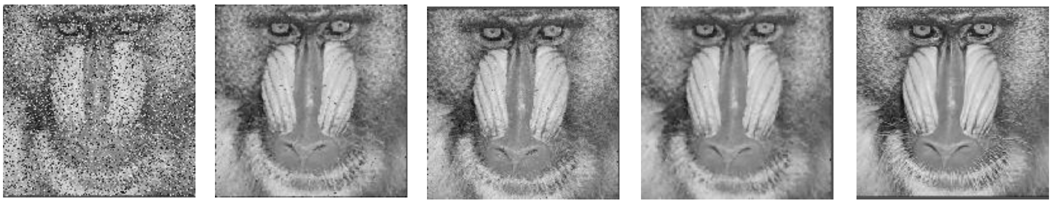
TABLE X. IMAGE QUALITY PERFORMANCE (PSNR IN DB) OF PROPOSED METHOD WHICH IS DEGRADED BY RVIN USING DIFFERENT SIZES OF FILTERING WINDOW.

Filtering Window size	10%	20%	30%	40%	50%	60%	70%
Gold-Hill							
3X3	38.45	38.53	37.47	38.08	38.43	38.06	38.16
5X5	32.53	34.89	34.57	32.53	32.44	32.47	32.65
7X7	32.80	32.72	29.86	32.71	32.72	29.87	28.93
Lena							
3X3	38.75	38.73	39.17	38.51	39.28	38.98	40.22
5X5	35.56	35.22	32.84	32.73	32.59	33.46	35.55
7X7	32.84	30.34	30.32	32.99	30.21	32.95	32.97
Mandrill							
3X3	36.17	37.09	36.89	36.82	36.84	36.03	36.54
5X5	31.07	31.36	31.11	29.57	29.53	31.37	29.61
7X7	28.08	25.73	26.16	26.20	28.01	28.06	28.04
Pepper							
3X3	38.86	39.09	39.40	39.04	39.58	39.07	40.22
5X5	33.55	33.37	34.57	33.22	34.40	33.54	31.13
7X7	**31.13**	**31.48**	**31.54**	**31.51**	**29.59**	**30.37**	**31.41**
Average Performance							
3X3	38.05	38.36	38.23	38.11	38.53	38.03	38.78
5X5	33.17	33.71	33.27	32.01	32.24	32.71	32.23
7X7	31.21	30.06	29.47	30.85	30.13	30.31	30.26

VII. RESULT ANALYSIS

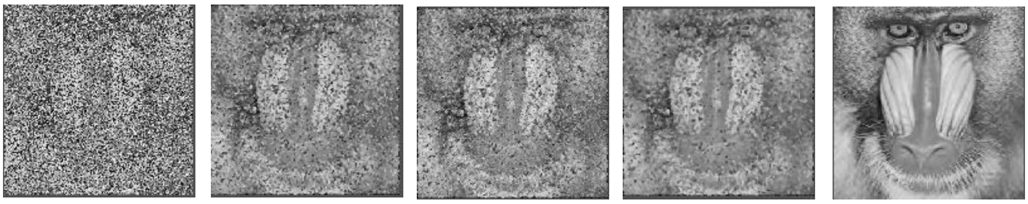
The image quality performance of different types of image de-noising methods is illustrated in Table 2, when applied on Gold-Hill image, for RVIN density ranging from 10% to 70%. When increases the noise density, then PSNR decreases for all methods, but proposed shown in Tables it gives improve value of PSNR at high density. As shown, proposed method shown much higher PSNR as compared to other denoising filters. The proposed result varied from 38.45% to 38.16% for this image. Results obtained with different de-noising methods for Lena image are shown in Table 3. Quality performance (PSNR)of proposed method reports 38.75% to 40.22%.In Table 5, PSNR values obtained through different median filter based de-noising methods for Pepper image are shown. As compared to PSM filtering based de-noising, proposed method results in an improvement of 38.86% to 40.22%.For Mandrill image, results are given in Table 4. The PSNR outcome of the proposed method is superior to all the other methods for noise densities up to 40%.The average performance of our proposed method, considering eight test images corrupted by RVIN is represented in Table 6 and Fig. 1. In Fig. 6, it is clearly visible that the performance curve of our proposed method is well above the existing de-noising methods.Among the existing methods, PSM method produces the best results. On 3X3 window size reached the PSNR value high upto 70% noise density. Through noise density increasing, the 5 X 5 window size performance becomes improvised and enhanced. The performance is dependent on image.With increase in window size, number of pixels in any window increases which results in higher complexity and time consumption. For lower noise density, various pixels corrupted through noise are less which results in high PSNR value with smaller size of window. For higher noise densities various pixels corrupted through noise are significant hence the de-noised image PSNR with higher window size achieves higher value due to higher accuracy resulting from more number of pixels under consideration for detection of noise at any specific pixel. The higher noise density is removed by our proposed method because optimum solution.Image results several filters on Mandrill image for 30% noise corruption through RVIN on 3X3 window are given in Fig. 3. PSNR value of our proposed method is calculated as 36.89 dB, which is the best among all.

Further in Fig. 4, the results of Mandrill image are given for 70% noise density on 5X5 window. Proposed method provides the PSNR of 36.54 dB at this level. Figs. 5 and 6 show the results of different filters in restoring Lena image corrupted by 30% and 70% noise density on 3X3 and 5X5 window size respectively.The restored image quality of the proposed technique is the best,both quantitatively and qualitatively. The obtained PSNR of our proposed process is 39.17 dB and 35.55 dB at the noise level of30% and 70% respectively.



(a) **(b)** **(c)** **(d)** **(e)**

Fig. 2. Results of different filters in restoring 30% corrupted Mandrill image: (a) Noisy Image, (b) MED , (c) PSMF, (d) ADTMF, (e) proposed method.

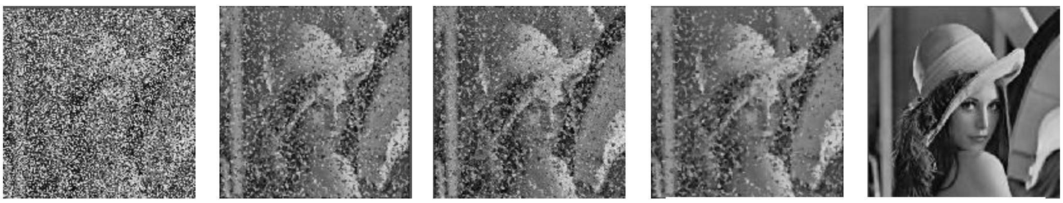


(a) **(b)** **(c)** **(d)** **(e)**

Fig. 3. Results of different filters in restoring 70% corrupted Mandrill image: (a) Noisy Image, (b) MED , (c) PSMF, (d) ADTMF, (e) proposed method.

(a) **(b)** **(c)** **(d)** **(e)**

Fig. 4. Results of different filters in restoring 30% corrupted Lena image: (a) Noisy Image, (b) MED , (c) PSMF, (d) ADTMF, (e) proposed method.



(a) **(b)** **(c)** **(d)** **(e)**

Fig. 5. Results of different filters in restoring 70% corrupted Lena image: (a) Noisy Image, (b) MED , (c) PSMF, (d) ADTMF, (e) proposed method.

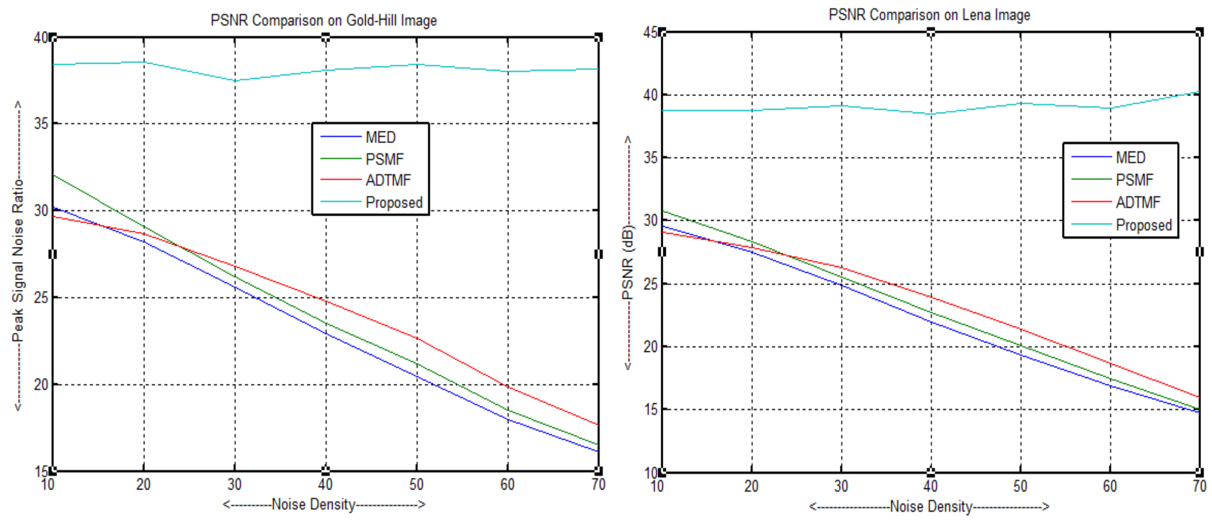


Fig. 6. Comparative chart of PSNR performance of different filters given in Table 2 and Table 3.

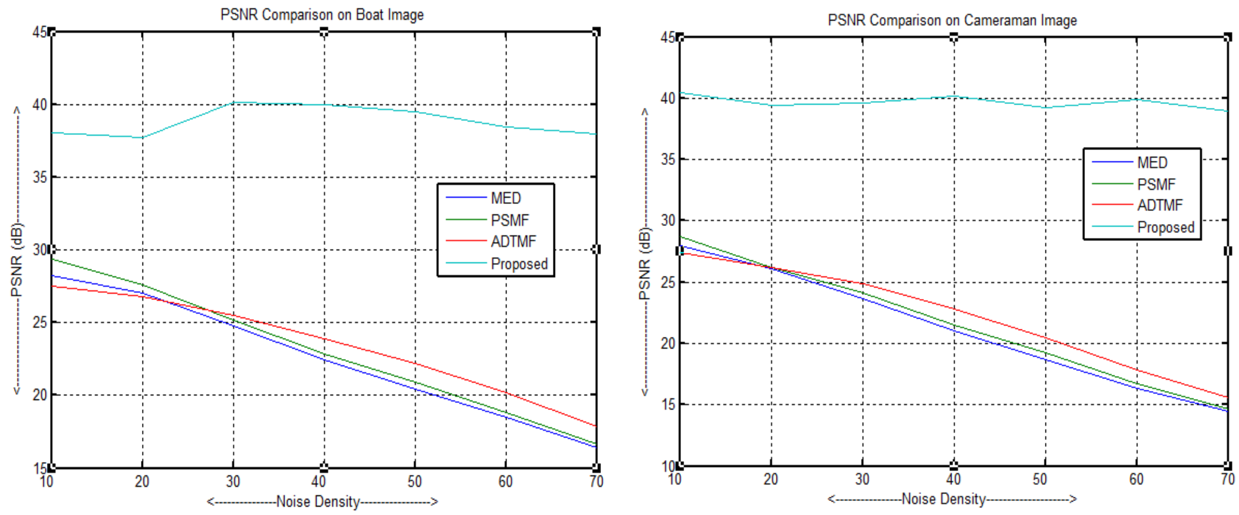


Fig. 7. Comparative chart of PSNR performance of different filters given in Table 6 and Table 7

VIII. EXISTING WORK

It presented a nonlinear median filter used in multiresolution environment, once in full resolution and next with semi resolution, denoising becomes more perfect. This method is useful to remove impulse noise but also Gaussian noise, Speckle noise. The visual class and denoising performance is seen using median filter not proved good for image quality[16]. On this technique picture noise is finded with a regular median filter utilising an adaptive window. Within the window, the long-established value of the center pixel is changed to a more recent that is toward or identical as the standard median. This work is done only on Gaussian noise and it is not feasible for high density noise[17]. It presented a pixel-wise adaptive neutrosophic filter founded on neutrosophic indeterminacy feature to remove high-level Salt-and-Pepper noise. Wide testing on many pictures demonstrate that with a 3X3 window, this process outperforms many present denoising methods in phrases of noise suppression and detail renovation.The limitation of this work is fixed window dimension and it is implemented only on 3X3 window size[18]. It presented a noise elimination approach founded on a semi-adaptive threshold in anisotropic diffusion filter to get higher detail understanding safeguard and better noise suppressing capacity. The picture quality is quite promising for visibility and edge preservarion. The performance of this model is not so good for high density noise [19]. It presented an improved Wavelet ICA filter, which could segregate the noise from Image. The suggested method using wavelet dimension reduction and normalizing the signal reduced the dimensionality through ICA that find independent noise characteristics and resolve the difficulty of Nonorthogonality by using Morlet wavelet if necessary[20]. A novel mannequin for impulse noise decrease with a recursive and noise-special fuzzy switching median filter is proposed. This method is not working in high density noise [6]. An improved image denoising technique founded on (Morphogonal Component Analysis) MCA and median filter is carried out in this paper to overcome above drawbacks. In this work, first it decomposed the image into structure image, texture image and edge image by adopting improved MCA algorithm. The image quality is degraded after removing noise [21]. It proposed a patch-based noise level estimation algorithm and advise that the noise stage parameter should be tuned in step with the scene complexity. The tuning process is done by considering both the noise level and image scene complexity.[22]

IX. CONCLUSION

This research presents and explores a new idea for image denoising using SOMA and ADTMF. There are two main process first is Noise Detection and Second is Noise Removal. In noise detection stage, the concept of averaging based dual threshold method is used which offers high noise detection ability and efficiency. After that, take threshold value from ADTMF and used this value for SOMA for noise removal. Simulation results present that the proposed technique of dual threshold is significantly superior various state-of-the-art method, both quantitatively and visually. It improvises vastly the de-noised image proposed Filter quality from 38.05% to 38.78% for 70% noise density. We have shown in this paper that SOMA is an efficient algorithm to find an optimal set of parameters for ADTMF denoising. The simulation results, and associated evaluation criteria represent that our method generates good results, much better than existing work. It helps in noise removal along with preservation of fine details much better than that obtained with other methods.

The work can be further extended to curvelets use. Also a similar thresholding method can also be used compression of aimage. Hybrid metaheuristics techniques may also be used to improve convergence behavior and quality of solution.

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