ISSN No: 2350-1278 (Print)
Peer Reviewed & Refereed Journal
National Research Journal

IMAGE SEGMENTATION USING REGION GROWING ALGORITHM OVER THE AWGN CHANNEL FOR BPSK AND QPSK MODULATION

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Abstract

Image segmentation is an important image processing technique which is used to analyze what is inside the image. Image segmentation is used to separate an image into several “meaningful” parts. In modern age, visual information is transmitted in the form of digital images becoming a major method of communication, but the image obtained after transmission is often corrupted with noise. The main aim of this thesis was evaluate the performance of image segmentation using region growing algorithm over the Additive White Gaussian noise channel. First part of this thesis, the segmented image was transmitted over the Additive White Gaussian noise channel using the Binary Phase Shift Key and the Peak Signal to Noise ratio, Signal to Noise ratio, Root Mean Square Error and Means Absolute Error of the segmented image were calculated by use of the median filter and without median filter. The region growing segmentation method and Additive White Gaussian noise channel was used for this thesis. And the second part of this thesis the segmented image was transmitted over the Additive White Gaussian noise channel using the Quadrature Phase Shift Key and the Peak Signal to Noise ratio, Signal to Noise ratio, Root Mean Square Error and Means Absolute Error of the segmented image were calculated by the use of median filter and without median filter. In base paper image was corrupted with noise and Peak Signal to Noise ratio, Root Mean Square Error were calculated by using the filters with and without filters.

Index Terms—: AWGN Channel, QPSK, BPSK, Image size, MAE, Median Filter PSNR, RMSE, SNR.

I. INTRODUCTION

Nowadays, image segmentation represents a task of growing importance in many different fields. This technique is finding broad applications in underwater acoustics, space born remote sensing, medical imaging systems, non-distractive material analysis, as well as spoken language processing. Binary Phase Shift Key (BPSK) is one of the best Communication System in which image can be transfer from one place to another through a communication channel. Hence the channel plays a very important role in Communication System. Sometimes ideal image cannot be received by receiver because of an Additive White Gaussian noise (AWGN) channel. In short image can be affected by communication Channel. Phase-shift keying is a digital modulation system that conveys data by modulating the phase of a mention signal. In figure 1 show the flow chart. The details of flow are described as First Original Image (A) to be load at input, after loading this image will convert into color image into gray image form (B)and resize the image(C)then applying the region growing algorithm(D) and add the salt and pepper noise(E) then image convert into binary form(F).after the binary convert ,image Then serial binary data (F) feed to Binary Phase Shift Key (BPSK) modulation to modulate & generate (F). After receiving (H), set the signal to noise ratio (SNR) values for the AWGN channel. This signal passes through noisy channel which is disturb by additive noise (AWGN). Resulting signal (H) is received and demodulated (I) then convert the binary form into image pixel form (J) that should be identical to input image (A).For every value of SNR, Bit error Rate (BER), Root Mean Square Value (RMSE) and Peak Signal to Noise Ratio (PSNR) changes after BPSK demodulation. find the output of the image (K),and calculate the value of Root Mean Square Value (RMSE) and Peak Signal to Noise Ratio (PSNR), Bit error Rate (BER)and Means Absolute error(MAE).

In figure 2 Show the flowchart representing of the image segmentation using the region growing algorithm over AWGN channel with median filter. The details of flow are described as First Original Image (A) to be load at input, after loading this image will convert into color image into gray image form (B)and resize the image(C)then applying the region growing algorithm(D) and add the salt and pepper noise(E) then image convert into binary form(F).after the binary convert ,image Then serial binary data feed to Binary Phase Shift Key (BPSK) modulation to modulate & generate (G), set the signal to noise ratio (SNR) values for the AWGN channel. This signal passes through noisy channel(H) which is disturb by additive noise (AWGN).

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Resulting signal (H) is received and demodulated (I) then convert the binary form into image pixel form (J)and then use the median filter for removing the noise(K). that should be identical to input image (A).For every value of SNR, Bit error Rate (BER), Root Mean Square Value (RMSE) and Peak Signal to Noise Ratio (PSNR) changes after BPSK demodulation. find the output of the image (L),and calculate the value of Root Mean Square Value (RMSE) and Peak Signal to Noise Ratio (PSNR), Bit error Rate (BER)and Means Absolute error(MAE).

II. Phase Shift Key (PSK) Modulation and Demodulation

Phase-shift keying (PSK) is a digital modulation scheme that conveys data by changing, or modulating, the phase of a reference signal. PSK modulation in Mat lab can be simulated using the pskmod() function and demodulation can be performed using pskdemod.

In BPSK system, change in phase of the sinusoidal carrier to indicate the information or data. In this system, if we pass the input binary (0) then the phase of sinusoidal will shift by 180 degree. Phase shift represent the change in state of information.

$$\mathrm{PSK}(t) = \begin{array}{l} \sin(2\pi ft)\, for bit 1 \\ \sin(2\pi ft + \pi)\, for bit 0 \end{array} \quad .$$

III. Image

In computer vision, Image is A two-dimensional signal that can be observed by human visual system. The image consists of number of elements called pixels and we process these pixels

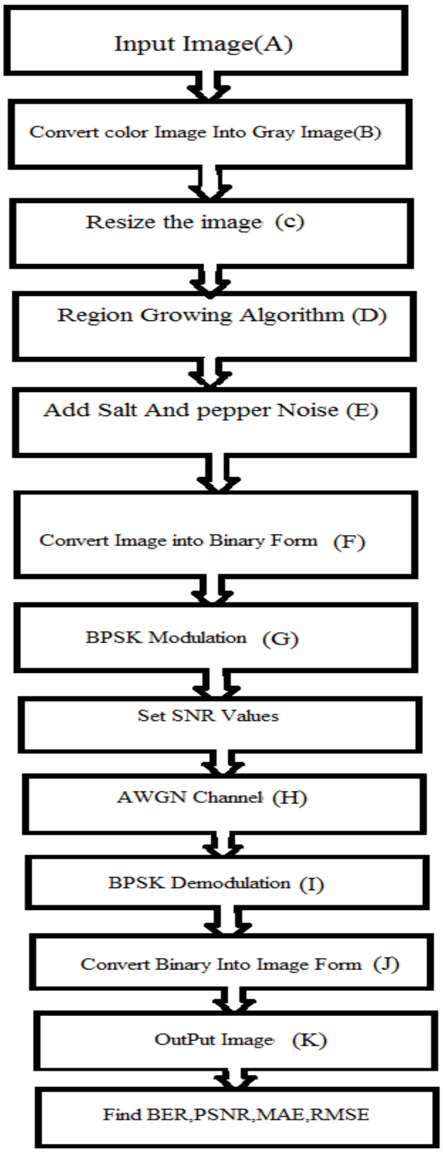

Figure1

In figure 1 Show the flowchart representing of the image segmentation using the region growing algorithm over AWGN channel.

IV. Salt and Pepper Noise

Salt and pepper noise is a form of noise typically seen on images. It represents itself as randomly occurring white and black pixels. An image containing salt-and-pepper noise will have dark pixels in bright regions and bright pixels in dark regions. This type of noise can be caused by dead pixels, analog-to-digital converter errors, bit errors in transmission, etc. This can be eliminated in large part by using dark frame subtraction and by interpolating around dark/bright pixels.

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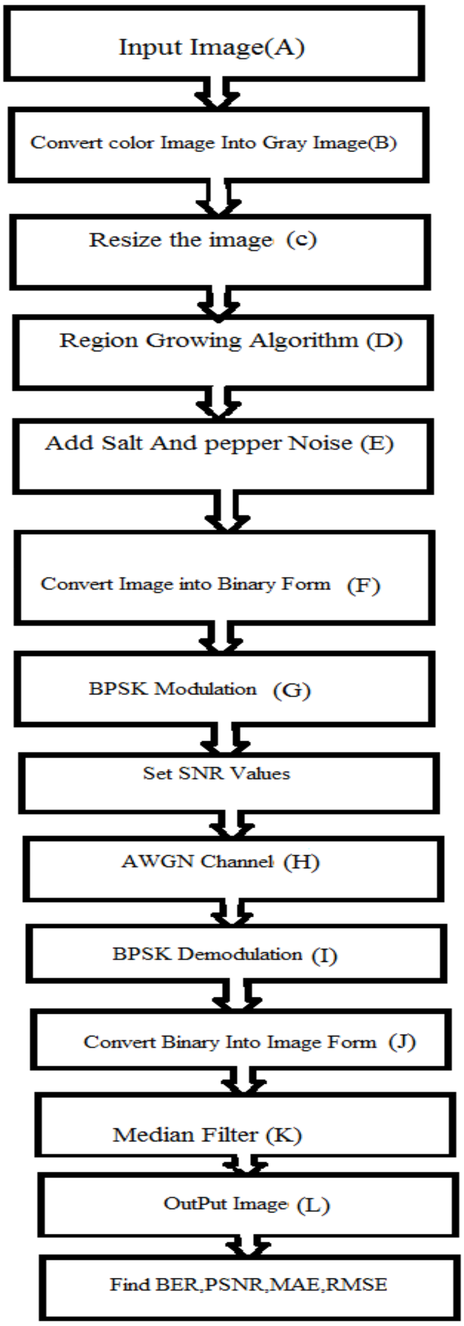

Figure2

In figure 2 Show the flowchart representing of the image segmentation using the region growing algorithm over AWGN channel with median filter.

V. Median Filter

The median filter is also a robust filter. The Median filter is a nonlinear digital filtering technique used for remove noise. Such noise reduction is a typical preprocessing step to improve the results of later processing (for example, edge detection on an image). Median filtering is very widely used in digital image processing because under certain conditions, it preserves edges whilst removing noise.

VI. Segmentation

Image segmentation refers to partitioning an image into different regions that are homogeneous or "similar" in some image characteristics. More precisely, image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain visual characteristics. The result of

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image segmentation is a set of segments that collectively cover the entire image, or a set of contours extracted from the image.

VII. Regional Growing

Region growing is a simple region-based image segmentation method. The principle of region growing is a collection of pixels with similar properties to form a region. The region based segmentation is partitioning of an image into similar/homogenous areas of connected pixels through the application of homogeneity/similarity criteria among candidate sets of pixels. Each of the pixels in a region is similar with respect to some characteristics or computed property such as gray character, color character or texture character.

VIII. Root Mean Square (RMSE)

In image processing area, the root mean square error (RMSE) is the square root of the average squared difference between every pixel in the distorted image and its matching part in the original image. The low value of RMSE means the lower of distortion.

The RMSE represented in eq:

$$RMSE = \sqrt{\frac{1}{M * N} \sum_{i=1}^{M} \sum_{j=1}^{N} [I(i,j) - \hat{I}(i,j)]^{2}}$$

IX. Peak Signal to Noise Ratio (PSNR)

PSNR is the ratio between maximum possible pixel of an image and the pixel of corrupting noise. PSNR is usually expressed in terms of the logarithmic decibel scale.

$$PSNR = \frac{10 \log \frac{1}{MN} \sum_{i=1}^{M} \sum_{j=1}^{N} \left| I(i,j) \right|^{2}}{MSE}$$

X. **Signal to Noise Ratio (SNR)**

Signal-to-noise ratio is defined as the power ratio between a signal (meaningful information) and the background noise (unwanted signal):

$$SNR = 10.\log_{10} \frac{\frac{1}{MN} \sum_{0}^{n_x - 1} \sum_{0}^{n_y - 1} [r(x,y)]^{2}}{\sum_{0}^{n_x - 1} \sum_{0}^{n_y - 1} \left[r(x,y) - t(x,y)^{2} \right]}$$

XI. Mean Absolute Error (MAE)

MAE or Mean Absolute Error is the arithmetic mean of the modulus of the difference between each value and the mean, given by

$$MAE = \frac{1}{N} \sum \left| K(i,j) - \hat{K}(i,j) \right|$$

Where: $K(i,j)$ represents one pixel in the original image (before embedding the hidden data), $\hat{K}(i,j)$ represents one pixel in the noisy image (after embedding the hidden data).

XII. Additive White Gaussian Noise

(AWGN)CHANNEL

An AWGN channel is a adds white Gaussian noise to the signal that passes through it. An AWGN channel is typically described by quantities such as Signal-to-Noise ratio (SNR) per sample and this is the actual input parameter to the AWGN function. The standard model of amplifier noise is additive, Gaussian, independent at each pixel and independent of the signal intensity, caused primarily by Johnson–Nyquist noise (thermal noise). In color cameras where more amplification is used in the blue color channel than in the green or red channel.

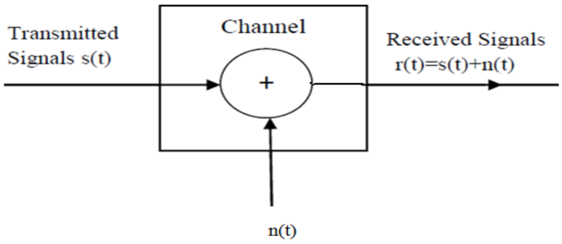

Figure 3

XII. Result

5.1 Results with and without Median filter for BPSK Modulation

5.1.1 Photographic Image for low thersholding level

Figure 5.1shows original image and figure 5.2 shows output of the segmented image, figure 5.3 shows the image after AWGN channel and figure 5.4 shows the output image.

Figure 5.1

Original Image

Figure 5.2

Segmented image

Figure 5.3

Image after AWGN channel

(A) Output without filter

(B) Output with median filter

Figure 5.4

Output image

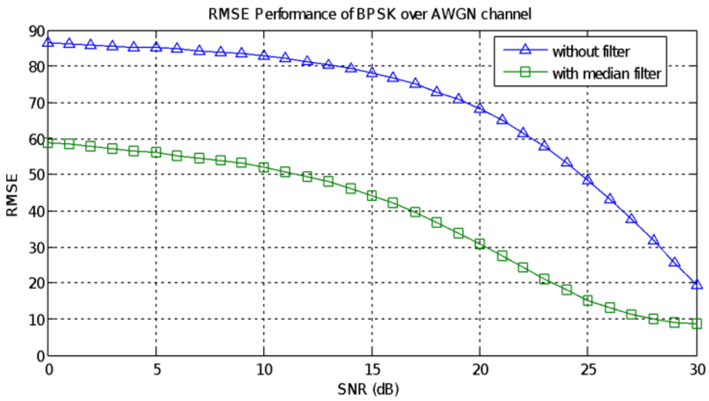

Figure 5.5

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Figure 5.5 shows Root Mean Square Value (RMSE) performance of image segmentation over the AWGN channel by using Median filter and without filter for BPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to Root Mean Square Value (RMSE) values decrease**.**

Observation Table

Table 1 shows SNR and RMSE performance of the segmented Image over AWGN channel by using Median filter and without filter for BPSK Modulation.

RMSE		SNR
with Median filter	**without Median filter**	
58.85452	86.55138	0
55.32705	84.99133	5
52.11237	82.90709	10
44.51597	78.11101	15
30.57750	68.14428	20
14.78529	48.72358	25
8.49709	19.41241	30

Table 1

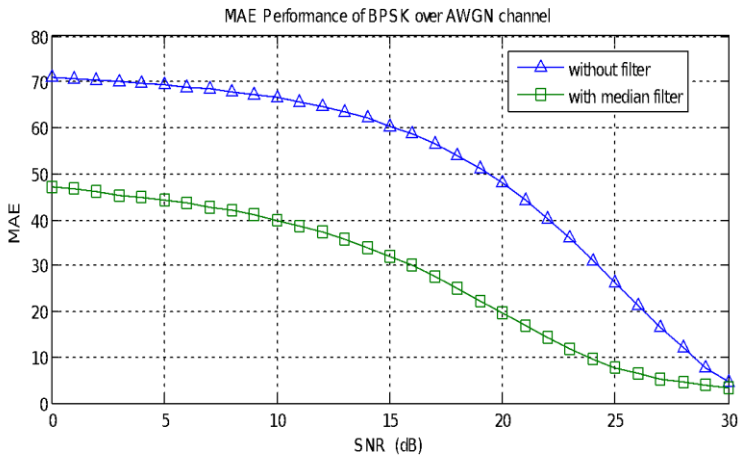

Figure 5.6

Figure 5.6 shows the Mean Absolute Error (MAE) performance of image segmentation over the AWGN channel by using Median filter and without filter for BPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to the Mean Absolute Error (MAE) values decrease**.**

Observation Table

Table 2 shows SNR and MAE performance of the segmented Image over AWGN channel by using Median filter and without filter for BPSK Modulation.

MAE	SNR

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with Median filter	without Median filter	
47.13628	71.17296	0
43.42936	69.13644	5
40.03088	66.54424	10
32.17481	60.44284	15
19.46526	48.01641	20
7.397028	26.06169	25
4.413623	5.396357	30

Table 2

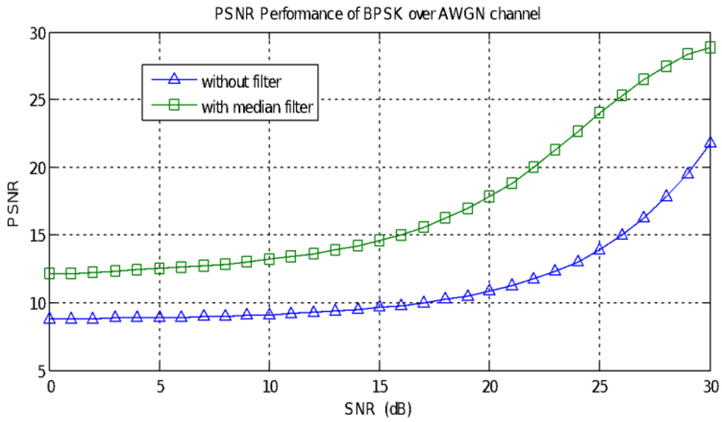

Figure 5.7

Figure 5.7 shows Peak Signal to Noise ratio (PSNR) performance of image segmentation over the AWGN channel by using Median filter and without filter for BPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to the Peak Signal to Noise ratio (PSNR) values increase**.**

Observation Table

Table 3 shows SNR and PSNR performance of the segmented Image over AWGN channel by using Median filter and without filter for BPSK Modulation.

PSNR		SNR
with Median filter	without Median filter	
12.09937	8.749486	0
12.63622	8.907474	5
13.15615	9.123133	10
14.52465	9.640722	15
17.78693	10.82638	20
24.09837	13.74018	25

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28.90956	21.73338	30

Table 3

5.1.2 Photographic Image for high thersholding level

Figure 5.8 shows original image and Figure 5.9 shows output of the segmented image, figure 5.10 shows the image after AWGN channel and figure 5.11 shows the output image.

Figure 5.8

Original Image

Figure 5.9

Segmented image

Figure 5.10

Image after AWGN channel

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(A) Output without filter

(B) Output with median filter

Figure 5.11

Output image

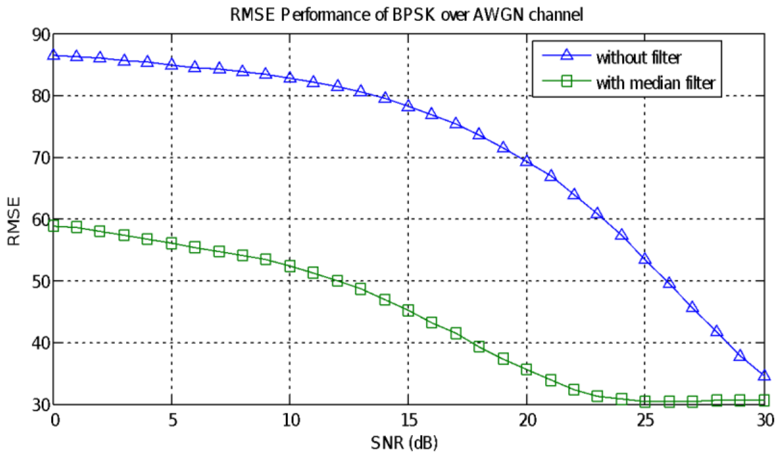

Figure 5.12

Figure 5.12 shows the Root Mean Square Value (RMSE) performance of image segmentation over the AWGN channel by using the Median filter and without filter for BPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to Root Mean Square Value (RMSE) values decrease**.**

Observation Table

Table 4 shows SNR and RMSE performance of the segmented Image over AWGN channel by using the Median filter and without filter for BPSK Modulation.

RMSE		SNR
with	without	

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Median filter	Median filter	
58.70118	86.49598	0
55.80354	84.51746	5
52.26577	82.93853	10
45.09848	78.16206	15
35.02338	69.35265	20
29.87281	53.54953	25
30.59259	34.43688	30

Table 4

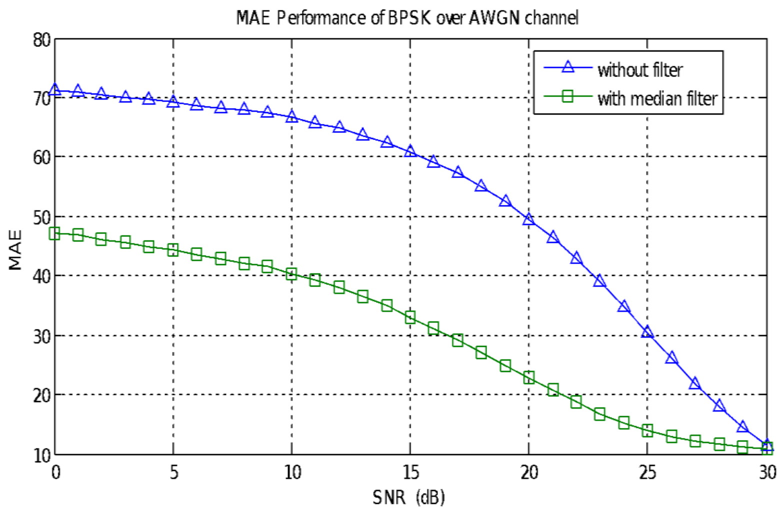


Figure 5.13

Figure 5.13 shows the Mean Absolute Error (MAE) performance of image segmentation over the AWGN channel by using the Median filter and without filter for BPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to the Mean Absolute Error (MAE) values decrease**.**

Observation Table

Table 5 shows SNR and MAE performance of the segmented Image over AWGN channel by using the Median filter and without filter for BPSK Modulation.

MAE		SNR
with Median filter	without Median filter	
47.06255	71.13475	0
43.95923	68.8346	5
40.38589	66.63713	10
33.01981	60.79403	15
22.55457	49.56285	20

13.54230	30.36964	25
10.79306	11.37202	30

Table 5

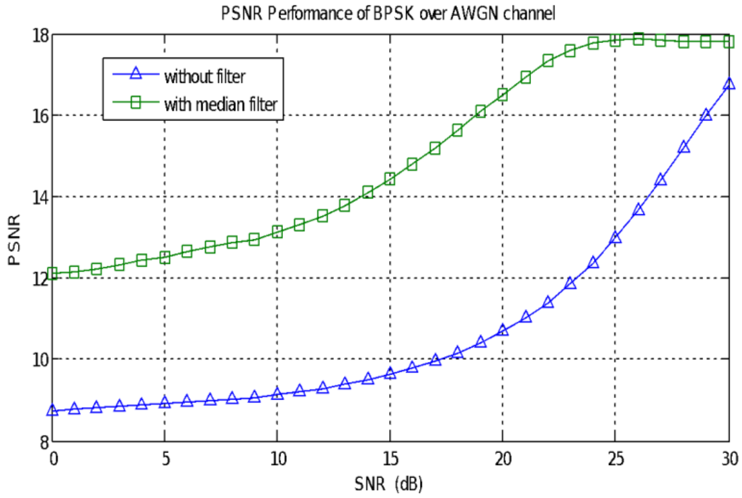


Figure 5.14

Figure 5.14 shows Peak Signal to Noise ratio (PSNR) performance of image segmentation over the AWGN channel by using the Median filter and without filter for BPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to the Peak Signal to Noise ratio (PSNR) values increase**.**

Observation Table

Table 6 shows SNR and PSNR performance of the segmented Image over AWGN channel by using the Median filter and without filter for BPSK Modulation.

PSNR		**SNR**
with Median filter	**without Median filter**	
12.12203	8.755048	0
12.56173	8.956038	5
13.13062	9.119841	10
14.41173	9.635047	15
16.60781	10.67371	20
17.68944	12.91985	25
17.78264	16.75449	30

Table 6

5.2 Results with and without Median filter for QPSK Modulation

5.2.1 Photographic Image for low thersholding level

Figure 5.15 shows original image and figure 5.16 shows output of the segmented image, figure 5.17 shows the image after AWGN channel and figure 5.18 shows the output of filter image.

Figure 5.15

Original Image

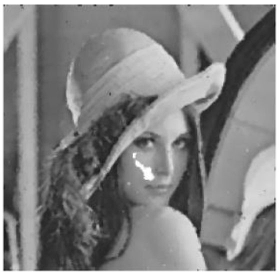
Figure 5.16

Segmented image

Figure 5.17

Image after AWGN channel

(A) Output without filter



(B) Output with median filter

Figure 5.18

Output image

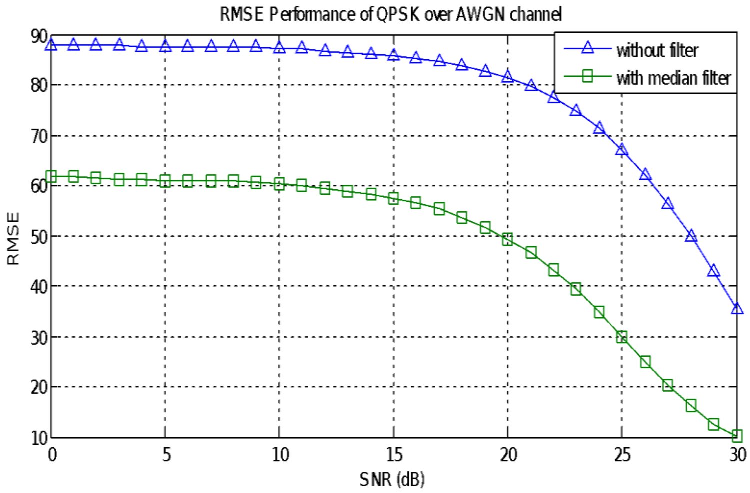


Figure 5.19

Figure 5.19 shows Root Mean Square Value (RMSE) performance of image segmentation over the AWGN channel by using the Median filter and without filter for QPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to Root Mean Square Value (RMSE) values decrease**.**

Observation Table

Table 7 shows SNR and RMSE performance of the segmented Image over AWGN channel by using the Median filter and without filter for QPSK Modulation.

RMSE		SNR
with Median filter	**without Median filter**	
61.60221	87.83417	0
60.84179	87.49665	5
60.49854	87.50518	10
86.08713	85.07584	15
49.9560	81.66022	20
30.71199	68.03613	25
10.25359	35.34943	30

Table 7

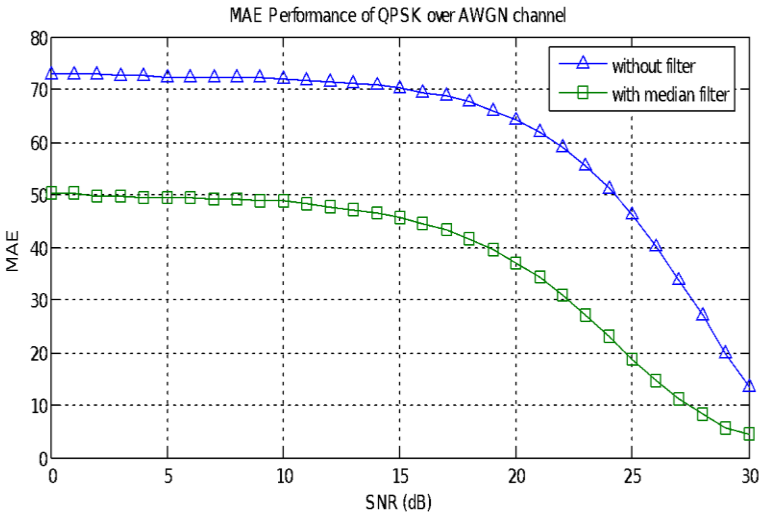


Figure 5.20

Figure 5.20 shows the Mean Absolute Error (MAE) performance of image segmentation over the AWGN channel by using the Median filter and without filter for QPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to the Mean Absolute Error (MAE) values decrease**.**

Observation Table

Table 8 shows SNR and MAE performance of the segmented Image over AWGN channel by using the Median filter and without filter for QPSK Modulation.

MAE		SNR
with Median filter	**without Median filter**	
50.14717	72.92874	0
49.25539	72.39351	5

48.90570	72.31987	10
46.16767	70.46565	15
37.64273	64.72991	20
18.70664	46.96692	25
4.445960	13.45879	30

Table 8

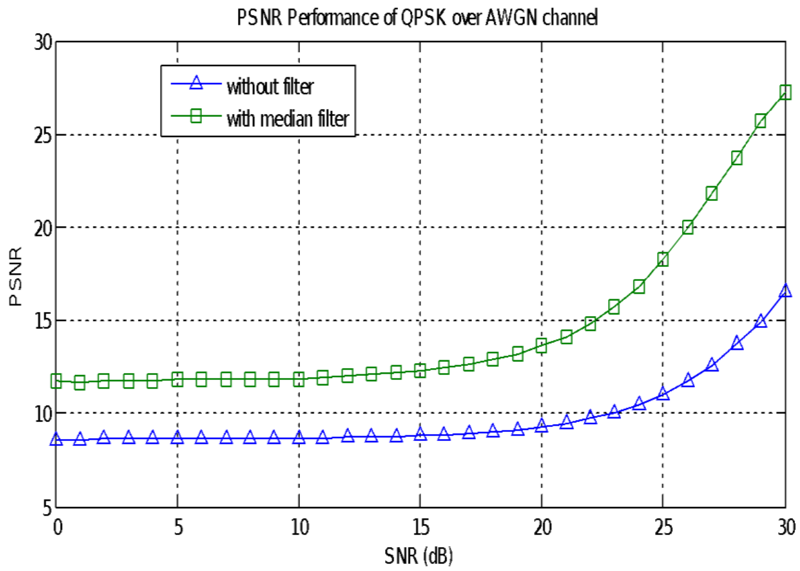


Figure 5.21

Figure 5.21 shows Peak Signal to Noise ratio (PSNR) performance of image segmentation over the AWGN by using the Median filter and without filter for QPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to the Peak Signal to Noise ratio (PSNR) values increase**.**

Observation Table

Table 9 shows SNR and PSNR performance of the segmented Image over AWGN channel by using the Median filter and without filter for QPSK Modulation.

PSNR		SNR
with Median filter	**without Median filter**	
11.70304	8.621697	0
11.81093	8.655138	5
11.86007	8.654292	10
12.21506	8.796202	15
13.52321	9.254756	20
17.74881	10.84017	25
27.27745	16.52732	30

Table 9

5.2.2 Photographic Image for high thersholding level

Figure 5.22 shows original image and figure 5.23 shows output of the segmented image, figure 5.24 shows the image over AWGN channel and figure 5.25 shows the output of filter image.

Figure 5.22

Original Image

Figure 5.23

Segmented image

Figure 5.24

Image after AWGN channel

(A) Output without filter

(B) Output with median filter

Figure 5.25

Output image

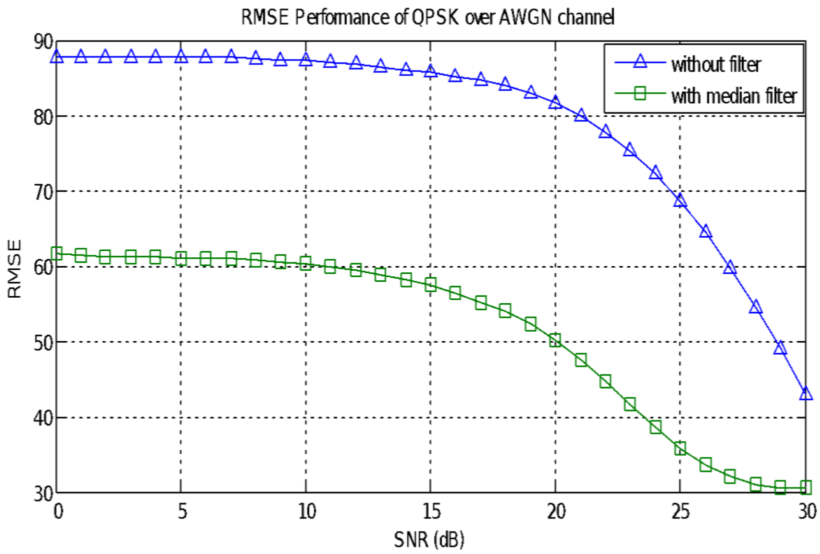


Figure 5.26

Figure 5.26 shows Root Mean Square Value (RMSE) performance of image segmentation over the AWGN channel by using the Median filter and without filter for QPSK Modulation. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to Root Mean Square Value (RMSE) values decrease.

Observation Table

Table 10 shows SNR and RMSE performance of the segmented Image over AWGN channel by using the Median filter and without filter for QPSK Modulation.

RMSE		SNR
with Median filter	**without Median filter**	
61.57394	87.79317	0
61.31548	87.58289	5
60.18041	87.26967	10
57.09057	85.31365	15
50.86284	81.89860	20
35.4405	69.56744	25
30.55854	43.03415	30

Table 10

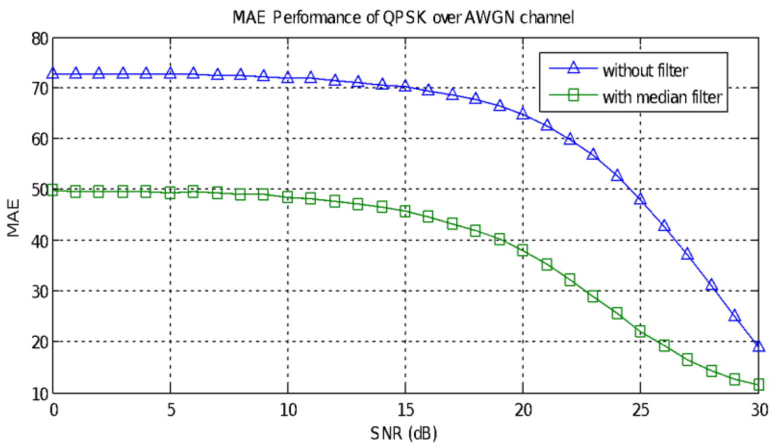


Figure 5.27

Figure 5.27 shows the Mean Absolute Error (MAE) performance of image segmentation over the AWGN channel by using the Median filter and without filter. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to the Mean Absolute Error (MAE) values decrease**.**

Observation Table

Table 11 shows SNR and MAE performance of the segmented Image over AWGN channel by using the Median filter and without filter.

MAE		SNR
with Median filter	**without Median filter**	
49.84957	72.71355	0
49.61677	72.65433	5
48.36169	71.96397	10

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45.41381	69.76937	15
38.74804	65.22800	20
22.10078	49.07369	25
11.65223	18.91207	30

Table 11

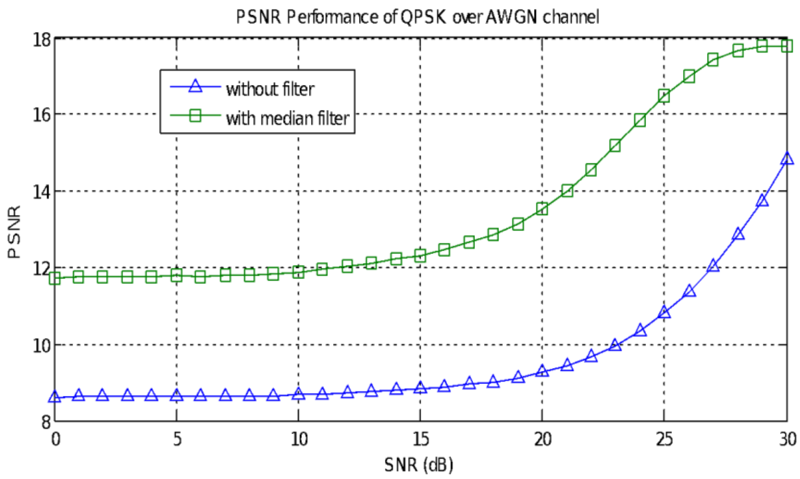

Figure 5.28

Figure 5.28 shows Peak Signal to Noise ratio (PSNR) performance of image segmentation over the AWGN channel by using the Median filter and without filter. It has been observed that with increase the Signal to noise ratio (SNR) values corresponding to the Peak Signal to Noise ratio (PSNR) values increase**.**

Observation Table

Table 12 shows SNR and PSNR performance of the segmented Image over AWGN channel by using the Median filter and without filter.

PSNR		**SNR**
with Median filter	**without Median filter**	
11.70703	8.625752	0
11.74356	8.612928	5
11.90586	8.677700	10
12.36368	8.874596	15
13.36696	9.229437	20
16.50497	10.64685	25
17.79232	14.81870	30

Table 12

XIV. Conclusion

Image segmentation and communication have become a very important task in today's scenario. In the present Day world computer vision has become an Interdisciplinary field and its applications can be found in any area be it medical, remote sensing, Electronics and so on . Thus, to find appropriate segmentation algorithm based on your application and the type of inputted image is very important.

In this paper, Table 1 shows the performance of image segmentation over the AWGN channel. And Table 2 shows the performance of image segmentation over the AWGN channel with and without median filter. It has been observed that with increase in the Signal to noise ratio (SNR) values, the Peak Signal to Noise ratio (PSNR) values also increase and Mean Absolute Error (MAE), Bit Error Rate (BER) and Root Mean Square Value (RMSE) values also decrease. Image segmentation is crucial for multimedia applications. Multimedia database utilize segmentation for the storage and indexing of images and video And, as shown by the results, image segmentation is used in video conferencing for compression.

REFERENCES

1) **R. C. Gonzalez and R. E. Woods**. Digital Image Processing. Addison Wesley, 2nd edition, 1992,
2) **P. K. Sahoo, S. Soltani and A. K. C. Wong,** "A Survey of Thresholding Techniques", Computer Vision, Graphics, and Image Processing, vol. 41, 133-260 (1988).
3) **N.Ikonomakis,K.N.Plataniotis,A.N.Venetsanopoulos,**"Color Image Segmentation for Multimedia Applications" published at Journal of Intelligent and Robotic Systems **28:** 5–20, 2000.
4) **Dr. (Mrs.) R.Sukanesh, R.Harikumar, N.S.Balaji and S.R.Balasubramaniam**, "Analysis of Image Compression by Minimum Relative Entropy (MRE) and Restoration through Weighted Region Growing Techniques for Medical Images", published at Engineering Letters, 14:1, EL_14_1_16 (Advance online publication: 12 February 2007)
5) **D. Dhouib, A. Naït-Ali, C. Olivier and M. S. Naceur**,"Performance Evaluation of Wavelet Based Coders on Brain MRI Volumetric Medical Datasets for Storage and Wireless Transmission", International Journal of Biological and Life Sciences 3:3 2007
6) **V.Jayaraj etal**, "High Density Salt and Pepper Noise Removal in Images using Improved Adaptive Statistics Estimation Filter" published at IJCSNS International Journal of Computer Science and Network Security, VOL.9 No.11, November 2009.
7) **Vidhi Rawat ,Alok jain,Vibhakar shrimali**, "Investigation and Assessment of Disorder of Ultrasound B-mode Images", (IJCSIS) International Journal of Computer Science and Information Security, Vol. 7, No. 2, February 2010
8) **Jun Tang,** "A Color Image Segmentation algorithm Based on Region Growing", 978-1-4244-6349-7/10/$26.00 _c 2010 IEEE
9) **Krishna Kant Singh , Akansha Singh**, "A Study Of Image Segmentation Algorithms For Different Types Of Images", IJCSI International Journal of Computer Science Issues, Vol. 7, Issue 5, September 2010 ISSN (Online): 1694-0814
10) **D.Maheswari & Dr.V.Radha**"Noise Removal in compound image using median filter" published at (IJCSE) International Journal on Computer Science and Engineering Vol. 02, No. 04, 2010, 1359-1362
11) **Pawan Patidar, Manoj Gupta, Sumit Srivastava, Ashok Kumar Nagawat**, "Image De-noising by Various Filters for Different Noise "published at International Journal of Computer Applications (0975 – 8887) Volume 9– No.4, November 2010
12) **Hussain F. Jaafar, Asoke K. Nandi and Waleed Al-Nuaimy**, " Detection of exudates from digital fundus image using a region based segmentation technique",19 European signal processing conference(EUSIPCO 2011)
13) **Ranjeet Kaur Sandhu, P.S. Maan**, "A spatial-domain filter for digital image De-noising used for Real time applications"published at IJCST Vol. 2, Issue 3, September 2011
14) **Shilpa Kamdi, R.K.Krishna"** Image Segmentation and Region Growing Algorithm" International Journal of Computer Technology and Electronics Engineering (IJCTEE) Volume 2, Issue 1,2012
15) **Ghule A.G. And Deshmukh P.R** "Image segmentation available techniques, open issues and region growing algorithm", Journal of Signal and Image Processing,ISSN: 0976-8882 & E-ISSN: 0976-8890, Volume 3, Issue 1, 2012, pp.-71-75
16) **Sonalir. Mahakale & Nileshsingh Thakur**"A Comparative Study of image filtering on various noisy pixels" published at International Journal of Image Processing and Vision Sciences ISSN (Print): 2278 – 1110, Volume-1, Issue-2, 2012
17) **Amandeep singh** "Performance Analysis of Segmentation Techniques" International Journal of Computer Applications (0975 – 8887)Volume 45– No.23, May 2012