Global Journal of Computer Science and Technology: F
Graphics & Vision
Volume 17 Issue 3 Version 1.0 Year 2017
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 0975-4172 & Print ISSN: 0975-4350

Alpha Trimmed Mean based JPEG Compression for an Objective Image Quality Enhancement of Noisy and Noise Less Images

By Vanitha Kakollu, G. Narasimha & P. Chandrasekhar Reddy
Gitam Institute of Science

Abstract- We can see that over the past few years, the number of people using the internet and the amount of information transmitted over the internet has grown to such a wide range. One of the best ways to reduce the image size is via image compression. In the compression of the still image, JPEG is better when it comes to bandwidth conservation. In this paper, we discussed an innovative JPEG compression algorithm with alpha-trimmed means based clustering. The proposed algorithm is expected to produce better results regarding MSE, PSNR and the number of bits transmitted when compared to the standard algorithms. The proposed JPEG algorithm enhances the speed and reduces the number of encoded bits, thereby reducing the amount of memory required. The reassembled image after decompression is as similar as the input image.

Keywords: *image compression, clustering, PSNR, MSE, AD, SC.*

GJCST-F Classification: *B.4.2, I.4.1*

Strictly as per the compliance and regulations of:

Alpha Trimmed Mean based JPEG Compression for an Objective Image Quality Enhancement of Noisy and Noise Less Images

Vanitha Kakollu [α] G. Narasimha [σ] & P. Chandrasekhar Reddy [ρ]

Abstract- We can see that over the past few years, the number of people using the internet and the amount of information transmitted over the internet has grown to such a wide range. One of the best ways to reduce the image size is via image compression. In the compression of the still image, JPEG is better when it comes to bandwidth conservation. In this paper, we discussed an innovative JPEG compression algorithm with alpha-trimmed means based clustering. The proposed algorithm is expected to produce better results regarding MSE, PSNR and the number of bits transmitted when compared to the standard algorithms. The proposed JPEG algorithm enhances the speed and reduces the number of encoded bits, thereby reducing the amount of memory required. The reassembled image after decompression is as similar as the input image.

Keywords: image compression, clustering, PSNR, MSE, AD, SC.

I. Introduction

The encoder generates a set of symbols when a two- dimensional image f(x, y) is given as an input. Then transmit this through a channel and the encoded image is now sent to the decoder. The decoder generates a reconstructed image f'(x, y). The output f'(x, y) is an accurate imitation of f(x, y) in lossless compression. Else it means that there is some misconception present in the re-enacted image [1].

The JPEG (Joint Photographic Experts Group), the committee that shaped the JPEG standard, is an identifiable lossy compression proposal. Not just using less memory, but also the data in the regenerated image in a JPEG compression appears very much identical. Though the quality is reduced with JPEG compression, the image will look nearly as similar as the original image.

The JPEG Algorithm wipes out high-frequency components that the human eye can't identify.

a) JPEG Algorithm

When compared to straight better, it involves the following steps.

1. The acquired image can be divided it into 8- pixel by 8-pixel blocks. If the image size is not precisely multiplied by 8, then add zeros in empty pixels around the edges.
2. For each 8-by-8 block, get image data such that you have values to represent the color at each pixel.
3. 8-by-8 blocks can be obtained from the Discrete Cosine Transform (DCT).
4. To make some values as zero from the DCT matrix, the DCT of each 8X8 block should be multiplied by a normalized mask.
5. Normalization abandons most of the high-frequency components. Next, the assortment of significant 2-D normalized DCT Coefficients by traversing in a ZIGZAG fashion and categorizing them in a 1-D array. In the 1-D array, the two types of DCT coefficients the first one is termed as direct current (DC) element, while other coefficients are called alternating current (AC) elements. Variable length Huffman coding is used to code AC components.
6. The reverse operation of compression is decompression. First calculate the normalized DCT values by decoding the compressed bit stream by Huffman code. Then organize all the DCT values in the 2-D array in a ZIGZAG fashion. We can obtain the decoded DCT values by multiplying them with normalized coefficients. Now an IDCT is executed on the denormalized DCT array. The decoding process engenders ensuing image block will not be identical to respective original image block used during encoding[1].

If in 8x8 blocks include a lot of dissimilarity in pixel values then the number of constructive DCT coefficients will grow to be more. Otherwise only first few DCT coefficients will be more noteworthy while others are zeros. On the application of filters, as a result the image gets smoothened the distinction of the pixel values of a block abridged [1].

II. Intended Innovative JPEG Compression Algorithms

If in 8x8 blocks include lot of distinction in pixel values then the number of constructive DCT coefficients will grow to be more. Otherwise only first few DCT coefficients will be more noteworthy while others are zeros. On the application of filters the image gets smoothened as a result the distinction of the pixel values of a block abridged.

Author α: Research Scholar, Department of CSE, JNTU Hyderabad, India.
e-mail: vanithajntuh@gmail.com
Author σ: Department of CSE,JNTUH College of Engineering, Sultanpur, Sangareddy, INDIA,
Author ρ: Department of Electronics and Communications. Engineering, JNTU Hyderabad, INDIA.

There are two different ways to implement the JPEG Algorithm.

1) Earlier than segregating the image into 8X8 blocks the images tainted with Poisson, Speckle, Salt & Pepper noise and Gaussian noise is convoluted with Alpha trimmed Mean filter.
2) Before the application of normalized matrix, the image is convoluted with the Alpha trimmed Mean filter.

This paper examines the comparison between the proposed approaches with the standard JPEG compression. The planned methods illustrate enhanced results compared to the JPEG in terms encoded bits. This paper implements the proposed algorithms by using MATLAB tools and the images are extracted from SIPI image database.

Algorithm1: Alpha trimmed Mean Based JPEG algorithm on noisy images.

Step1: Read the image.

Step 2: Apply speckle/Poisson/ Gaussian/ Salt & Pepper Noise.

Step 3: Apply Alpha trimmed Mean.

Step 4: Standard Jpeg Compression [8, 9].

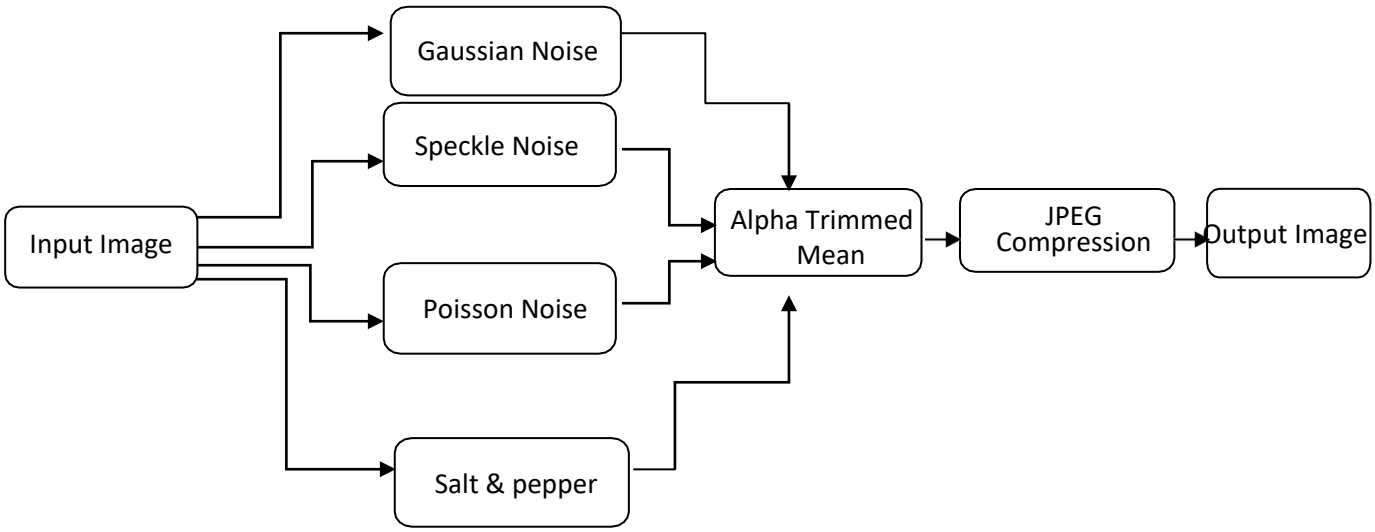

Fig.1: Structure of Planned JPEG algorithms on images corrupted with various types of noise.

Algorithm 2: Alpha trimmed Mean based JPEG Algorithm on regular images.

Step1: Read the image.

Step 2: Apply the smoothening operator Alpha trimmed Mean.

Step 3: Standard Jpeg Compression [7, 8, 9].

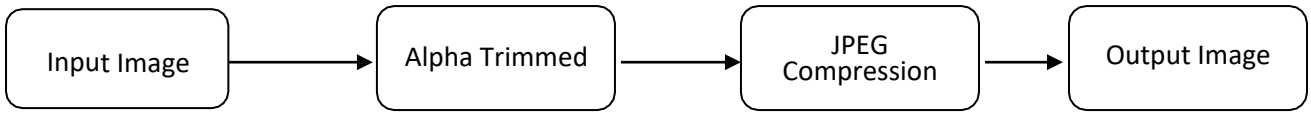

Fig. 2: Structure of Planned JPEG algorithms on images corrupted with various types of noise.

III. Implementation of Planned JPEG Algorithms

In this paper Alpha trimmed mean based JPEG compression is executed on images of different sizes. Contemplation of results entrusts that the lately expected compression techniques are enormously a prominent alternate since they are proved to be better regarding image quality metrics like PSNR, MSE, AD, SC, Compression ratio.

N1 is the extent of information hauling units required to imply uncompressed dataset and N2 is the number of entities in the encoded dataset. The units for N1 and N2 are same.

$$CR = N1/N2$$

The reconstructed image is identical to the original image with lossless compression algorithms as they not only swab out redundancy but also eradicates the redundancy present in the data they even guard all the information that is present in the input image.

Higher compression is achieved in lossy compression algorithms as the output image and the input image will not be similar. We can either use subjective fidelity criteria or objective fidelity criteria for comparing the original and reprocessed image. An example for objective fidelity criteria is Root mean square (RMS) error.

Measurement of the image quality is an imperative implication in image processing. In many of the image processing applications, estimation is a compulsion for the excellence of the image. The judgment of the quality of an image by the human is not sufficient. Therefore some more metrics like PSNR (Peak Signal to Noise Ratio) and MSE (Mean Square Error) are needed. PSNR is one of the specialized image quality metric. The differences between the restructured image and the input image will be small when the PSNR value is high.

This paper spot the comparison between the proposed Alpha trimmed Mean based approaches with the standard JPEG compression. The premeditated approaches exemplify improved results contrasted to the JPEG. Out of these proposed JPEG compressions the Alpha Trimmed Mean filter on images corrupted with on Poisson noise in *algorithm1*, Alpha trimmed Mean on images encodes the images with a fewer number of bits, as a result the images will be transmitted with high speed. The decisive insinuation in image processing is the amount of image quality. Evaluation and assessing are obligatory for image quality in many image processing implementations. The refinement of human to boost the image quality is not adequate. So we necessitate some additional image quality metrics like Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR).

The number of encoded bits required to characterize the compressed image is minimized with the Alpha trimmed Mean. The corrupted images with Poisson noise in the proposed algorithm resulted a high compression ratio compared to the standard JPEG compression technique.

IV. Results

This paper presents the evaluation between the proposed Alpha trimmed mean based JPEG approaches with the standard JPEG compression. The wished-for approaches typify improved results compared to the JPEG. This paper makes use of MATLAB tools to access the proposed algorithm and the images are from SIPI image database.

Table 1: Alpha Trimmed mean JPEG Compression on Images corrupted with *Gaussian noise* of size 256X 256.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	38915	35567	40756	48505
Saved bits	485373	488721	483532	475483
RMS Error	1.99	2.14	2.16	2.95
Compression ratio	13.47	14.74	12.86	10.8
PSNR	42.19	41.55	41.48	38.76
MSE	3.96	4.58	4.66	8.71

Table 2: Alpha Trimmed mean JPEG Compression on Images corrupted with *Gaussian noise* of size 512×512.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	160880	185945	151629	171235
Saved bits	1936272	1911207	1945523	1925917
RMS Error	1.98	2.15	1.92	1.97
Compression ratio	13.03	11.27	13.83	12.24
PSNR	48.27	47.54	48.52	48.30
MSE	3.91	4.61	3.68	3.88

Table 3: Alpha Trimmed mean JPEG Compression on Images corrupted with *Salt & Pepper noise* of size 256×256.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	33233	32096	37968	52879
Saved bits	491055	492192	486320	471409
RMS Error	1.62	2.21	1.96	2.66
Compression ratio	15.77	16.33	13.80	9.91
PSNR	43.95	41.28	42.30	39.67
MSE	2.64	4.88	3.86	7.07

Table 4: Alpha Trimmed mean JPEG Compression on Images corrupted with *Salt & Pepper noise* of size 512×512.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	138715	173238	130268	152700
Saved bits	1958437	1923914	1966884	1944452
RMS Error	1.60	1.88	1.54	1.58
Compression ratio	15.11	12.10	16.09	13.73
PSNR	50.12	48.71	50.42	50.22
MSE	2.55	3.52	2.37	2.49

Table 5: Alpha Trimmed mean JPEG Compression on Images corrupted with *Poisson noise* of size 256 X 256.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	31807	28385	34746	46210
Saved bits	492481	495903	489542	478078
RMS Error	1.56	1.86	1.86	2.49
Compression ratio	16.48	18.47	15.08	11.34
PSNR	44.28	42.76	42.78	40.22
MSE	2.44	3.47	3.46	6.22

Table 6: Alpha Trimmed mean JPEG Compression on Images corrupted with *Poisson noise* of size 512 X512.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	134461	170584	124837	151040
Saved bits	196261	1926568	1972315	1946112
RMS Error	1.55	1.78	1.46	1.54
Compression ratio	15.59	12.29	16.79	13.88
PSNR	50.37	49.17	50.87	50.45
MSE	2.41	3.17	2.14	2.37

Table 7: Alpha Trimmed mean JPEG Compression on Images corrupted with *Speckle noise* of size 256X256.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	32309	27980	34650	46407
Saved bits	492249	496308	489638	477881
RMS Error	1.56	1.82	1.92	2.46
Compression ratio	16.36	18.73	15.13	11.29
PSNR	44.33	42.96	42.50	40.35
MSE	2.42	3.31	3.69	6.04

Table 8: Alpha Trimmed mean JPEG Compression on Images corrupted with *Speckle noise* of size 512X512.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	134490	170840	124478	150890
Saved bits	1962662	1926312	1972674	1946262
RMS Error	1.53	1.82	1.46	1.54
Compression ratio	15.59	12.27	16.84	13.89
PSNR	50.52	49.00	50.90	50.44
MSE	2.33	3.30	2.13	2.37

Table 9: JPEG Compression on Images corrupted with *Gaussian noise* of size 256X256.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	131762	128052	130105	112493
Saved bits	392526	396236	394183	411795
RMS Error	8.30	8.21	8.14	7.18
Compression ratio	3.97	4.09	4.02	4.66
PSNR	29.79	29.88	29.95	31.04
MSE	68.84	67.39	66.25	51.56

Table 10: JPEG Compression on Images corrupted with *Speckle noise* of size 256X256.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	534501	571916	523400	543731
Saved bits	1562651	1525236	1573752	1553421
RMS Error	8.24	8.22	8.28	8.29
Compression ratio	3.92	3.66	4.00	3.85
PSNR	35.86	35.89	35.82	35.82
MSE	67.97	67.49	68.57	68.64

Table 11: JPEG Compression on Images corrupted with *Speckle noise* of size 512X512.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	85872	107713	110033	107065
Saved bits	438416	416575	414255	417223
RMS Error	7.07	7.81	7.65	6.96
Compression ratio	6.10	4.86	4.76	4.89
PSNR	31.18	30.32	30.49	31.31
MSE	49.99	60.93	58.54	48.46

Table 12: JPEG Compression on Images corrupted with *Speckle noise* of size 512X512.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	352151	422756	344034	354298
Saved bits	1745001	1674396	1753118	1742854
RMS Error	6.79	6.99	7.06	6.65
Compression ratio	5.95	4.96	6.09	5.91
PSNR	37.55	37.30	37.21	37.72
MSE	46.07	48.81	49.86	44.27

Table 13: JPEG Compression on Images corrupted with *Poisson noise* of size 256X256.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	81211	86149	91099	93492
Saved bits	443077	438139	433189	430796
RMS Error	6.71	6.92	6.94	5.68
Compression ratio	6.45	6.08	5.75	5.60
PSNR	31.63	31.36	31.34	33.08
MSE	45.08	47.92	48.19	32.26

Table 14: JPEG Compression on Images corrupted with *Poisson noise* of size 512X512.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	333965	408287	320709	347564
Saved bits	1763187	1688865	1776443	1749588
RMS Error	6.41	6.81	6.61	6.52
Compression ratio	6.27	5.13	6.53	6.03
PSNR	38.05	37.52	37.78	37.89
MSE	41.11	46.39	43.73	42.57

Table 15: JPEG Compression on Images corrupted with *Salt & Pepper* size 256X256.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	100843	97834	102094	118128
Saved bits	423445	426454	422194	406160
RMS Error	6.65	5.95	5.98	5.85
Compression ratio	5.19	5.35	5.13	4.43
PSNR	31.7	32.68	32.64	32.82
MSE	44.27	35.35	35.71	34.22

Table 16: JPEG Compression on Images corrupted with *Salt & Pepper* size 512X512.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	412269	485030	396350	433858
Saved bits	1682883	1612122	1700802	1663294
RMS Error	6.34	6.96	6.38	6.73
Compression ratio	5.06	4.32	5.29	4.83
PSNR	38.14	37.34	38.09	37.63
MSE	40.19	48.42	40.69	45.28

Table 17: Alpha trimmed Mean JPEG Compression on Images of size 256X256.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	29370	22971	30094	45560
Saved bits	494918	501317	494194	478728
RMS Error	1.35	1.68	1.48	2.17
Compression ratio	17.85	22.8	17.42	11.5
PSNR	45.58	43.68	44.78	41.44
MSE	1.81	2.81	2.18	4.71

Table 18: Alpha trimmed Mean JPEG Compression on Images of size 512X512.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	126602	168049	115194	147353
Saved bits	1970550	1929103	1981958	1949799
RMS Error	1.35	1.74	1.29	1.43
Compression ratio	16.56	12.47	18.2	14.23
PSNR	51.57	49.37	51.97	51.05
MSE	1.83	3.03	1.67	2.06

Table 19: JPEG Compression on Images of size 256X256.

Images	5.1.09	5.1.11	5.1.12	5.1.13
No of Bits Required	60840	40534	50289	65622
Saved bits	463448	483754	473999	458666
RMS Error	4.25	2.26	3.04	3.6
Compression ratio	8.61	12.93	10.42	7.98
PSNR	35.59	41.10	38.50	37.5
MSE	18.10	5.09	9.26	12.94

Table 20: JPEG Compression on Images of size 512X512.

Images	5.2.08	5.2.10	7.1.03	7.1.05
No of Bits Required	246431	363397	243255	298239
Saved bits	1850721	1733755	1853897	1798913
RMS Error	3.48	5.39	3.8	4.7
Compression ratio	8.51	5.771	8.62	7.03
PSNR	43.35	39.55	42.58	40.74
MSE	12.11	29.09	14.46	22.11

V. Conclusion

In this paper, Alpha trimmed mean based JPEG compression algorithm is proposed. This algorithm is evaluated with standard JPEG algorithm. The proposed algorithm uses less encoded bits for compression of images and hence the loading and storing of the image took less time. Also, the mean square error (MSE) of the proposed approach is low compared to the regular JPEG. Due to the peak signal noise ratio (PSNR) perfect classification correctness is augmented with the estimated approach. The projected compression ratio can be realized with good quality image with necessary planned algorithm compared to JPEG compression technique. The requirement of encoded bits to represent the compressed image is less compared to JPEG compression. Also the image corrupted with various types of noises like Gaussian, Poisson, Speckle, Salt & Pepper noise are compressed efficiently with alpha trimmed JPEG compression. This proposed alpha trimmed JPEG compression algorithm eliminates the noise and encodes the image with fewer number of bits compared JPEG compression technique.

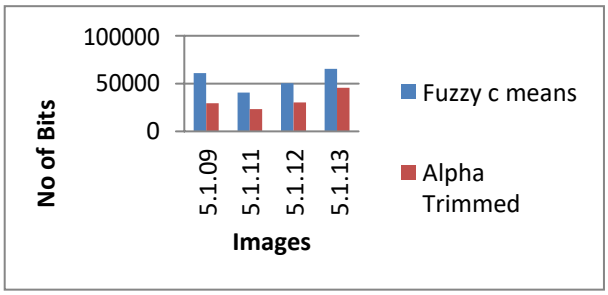

Fig. 1: Comparison between JPEG and Alpha trimmed mean in terms of No of bits transmitted for images of size 256×256

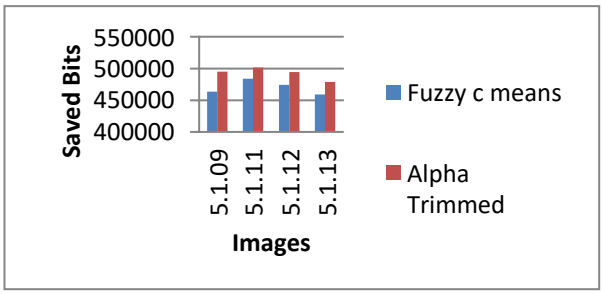

Fig. 2: Comparison between JPEG and Alpha trimmed mean in terms of Saved bits transmitted for images of size 256×256

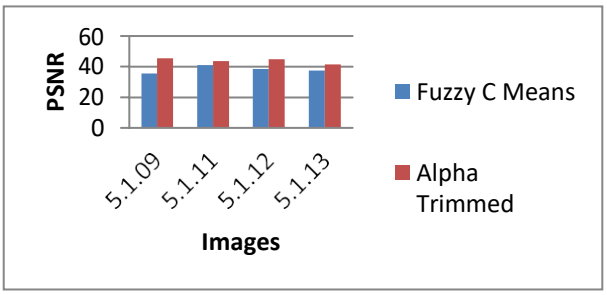

Fig. 3: Comparison between JPEG and Alpha trimmed mean in terms of PSNR transmitted for images of size 256×256

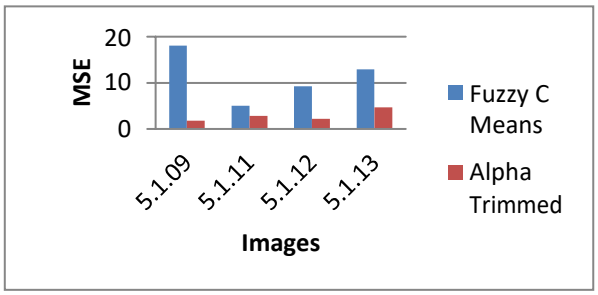

Fig. 4: Comparison between JPEG and Alpha trimmed mean in terms of MSE transmitted for images of size 256×256

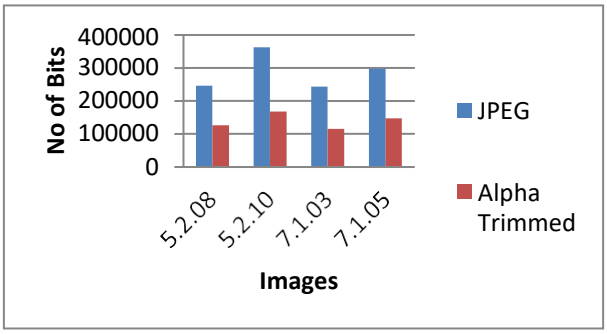

Fig. 5: Comparison between JPEG and Alpha trimmed mean in terms of No of bits transmitted for images of size 256×256

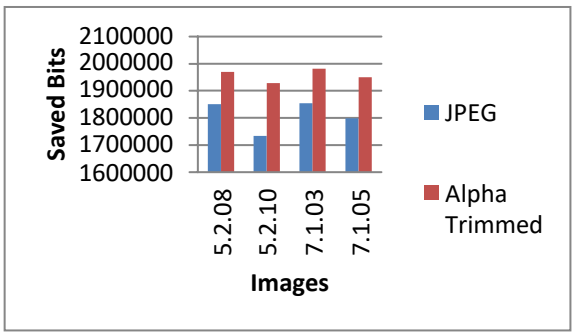

Fig. 6: Comparison between JPEG and Alpha trimmed mean in terms of Saved bits transmitted for images of size 256×256

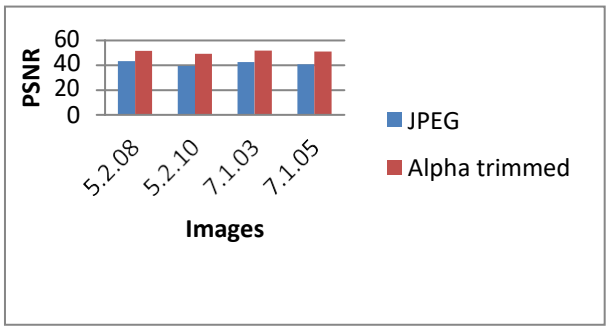

Fig. 7: Comparison between JPEG and Alpha trimmed mean in terms of PSNR transmitted for images of size 256×2

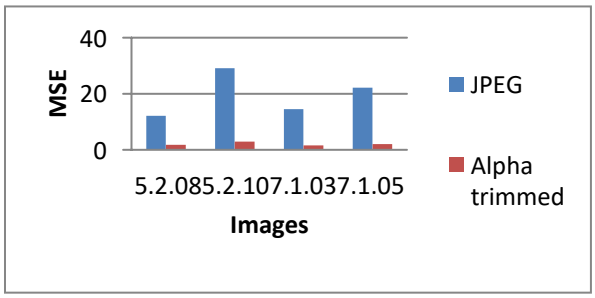

Fig .8: Comparison between JPEG and Alpha trimmed mean in terms of MSE transmitted for images of size 256×256

References Références Referencias

1. Olivier Egger and Wei Li, "Very Low Bit Rate Image Coding using morphological operators and Adaptive Decompositions" IEEE International Conference on Image Processing Vol-3, Nov-1994, PP No.326-330.
2. Ricardo L. de Queiroz, Member IEEE, "Processing JPEG-Compressed Images and Documents" IEEE Transactions on Image Processing, Vol. 7, No. 12, December 1998, PP No: 1661-1672.
3. Ravi Prakash, IEEE Member, Joan L. Mitchell, IEEE Fellow, and David A. Stepneski, "Enhanced JPEG Compression of Documents" IEEE International Conference on Image Processing Vol-3, Oct-2001, P P No: 494-497.
4. Bai Xiangzhi, Zhou Fugen, "Edge Detection Based on Mathematical Morphology and Iterative Thresholding" IEEE International Conference on Image Processing Vol-2, Nov-2006, PP No: 1849- 1852.
5. Sreelekha G and P.S. Sathidevi,+ "An Improved JPEG Compression Scheme Using Human Visual System Model" IEEE, June 2007, PP No: 98-101.
6. G. Srinivas, Prof Prasad Reddy P.V.G.D, and K.ramya "An N-Square Approach for Reduced Complexity Non-Binary Encoding", GJCST, PP No: 36-39, Vol: XI Issue XI.

7. Ch. Ramesh, N.B. Venkateswarlu and J.V.R Murthy, "Filter Augmented JPEG Compressions" IJCA, Vol-60, No-17, Dec-2012. PP No: 1-5.
8. Marlapalli Krishna, G.Srinivas and Prasad Reddy PVGD" Image Smoothening and Morphological operators Based JPEG Compression", JATIT, Vol.85, No.3, PP No: 252-259, March 2016.
9. Marlapalli Krishna, Prasad Reddy PVGD and G. Srinivas" A Smoothening based JPEG Compression for an Objective Image Quality Enhancement of Regular and Noisy Images, IJAER, Vol.11, No.6, P P No: 3799-3804, 2016.
10. G. Srinivas, P. Naga Srinivasu, T. Srinivasa rao and Ch. Ramesh "Harmonic and Contra Harmonic Mean Centric JPEG Compression for an Objective Image Quality Enhancement of Noisy Images", Springer, International conference on smart computing and its application PP No143-152, 2017.