

CPBD Metric for Blur Detection of a No Reference Image & It's Removal

Rohan Vijay Sonawane¹, Prof. K Sujatha²

M.E (VLSI& Embedded Systems) (Appeared), Department of Electronics & Tele-Communication Engineering,
Shree Ramchandra College of Engineering Lonikand (Pune), Maharashtra India¹

Ph.D. H.O.D. Department of Electronics & Tele-Communication Engineering, Shree Ramchandra College of
Engineering, Lonikand (Pune), Maharashtra India.²

ABSTRACT: This paper is based on the commutative probability of blur detection in the no reference image .it includes study of sensitivity of human blur perception at different contrast values. This is a no reference image sharpness metric in which probabilistic model is formed which detects blur at each edge in the image. This information of blur perception is then pooled over whole image which gives final quality score by calculating Cumulative Probability of Blur Detection (CPBD). Larger value of CPBD shows image with sharper regions. Smaller value of CPBD indicates noisy & blurred images. The results obtained using CPBD are compared with already established several sharpness metrics for different databases .the applications of CPBD includes telemedicine & IQM (Image Quality Measure)..

KEYWORDS: No reference, Image Quality Measure, sharpness metric, distorted images, probability, blur detection

I. INTRODUCTION

Now a day there is very high demand for digital image and video in applications such as Security, Communication, Medical and Entertainment. So there is need of accuracy in the quality of images. But transmission of images includes its compression and processing before transmission. This affects the quality of images. That means it introduces noise in the images. These noise/distortions should be detected at the receiver [1]. So several image quality evaluation ways are required to measure quality of received image. As cost, simplicity, reliability is important issues in life, it is necessary to develop reliable image quality metrics. Image quality is an important feature of image that calculates amount of distortion in the image [2]. Image quality measure has two types: subjective and objective. Subjective IQM includes human observations considering that Human Vision System (HVS) is the final receiver of picture information. But subjective IQM is not practical due its several drawbacks like requirement of many persons, less accuracy, more time. Objective IQM is feasible for real time applications due to its reliability, low cost and simplicity. So presently many industries and & researches are taking interest in it for internet applications. It involves quantitative analysis to compute images quality metrics with adjustment in quality of image [3]. Objective IQM is divided into three types depending on amount of reference information available. The types are full reference (FR) which includes availability of original image to be compared with image under observation. Reduced reference (RR) is another type in which reference image features are extracted. But these features are not sufficient to find image quality score or comparison [4]. In practical the original image or its partial information is not available/costly. So no reference quality major comes into picture. But same efforts are required to develop all these metrics.This paper gives idea about computing quality of image without reference using Cumulative Probability of Blur Detection CPBD [5]. Distortions/noise in the image is mainly because of loss of high frequency Information. This loss occurs due to several processing stages before transmission. The established methods are unable to find relative blurriness in images having different contents. So this paper proposes no reference objective blur metric using Cumulative Probability of Blur Detection CPBD [5]. It includes method of Just Noticeable Blur (JNB) [6] together with CPBD. This probabilistic model detect blur at each edge in the image. This information is then pooled over whole image to obtain final quality score using CPBD. CPBD metric has

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 8, August 2016

value ranging from 0.0 to 1.0. So if blur in the image increases, CPBD value decrease up to 0.0 and vice versa. The CPBD metric value 1.0 represents quality image without noise/ less noise [6]. This paper is divided into different sections: Section II shows no reference objective Image quality measures. Proposed cumulative probability of blur detection metric is presented in section III. Section IV gives idea about performance result and conclusion is stated in section v.

II. NO REFERENCE OBJECTIVE IMAGE QUALITY MEASURES

It is related to computation of image noise at receiver without any information of original image. It is used in the places where no information about original image is available. Computation of no reference image quality is based on blur distortions. The combination of several sharpness metrics with other metrics is formed to get overall image quality. Local Phase Coherence[7] metric is based on weighted averaging method in which calculated LPC values are separated and same is used to obtain only one sharpness index. The higher weights show higher LPC values which indirectly indicate quality image regions.

In this paper, we proposed the combination of Just Noticeable Blur (JNB) and Cumulative Probability of Blur Detection CPBD. It was shown that JNB [6] cannot predict relative sharpness in images showing dissimilar content. We compared the result of proposed work with these metrics over a large database images.

III. PROPOSED CUMULATIVE PROBABILITY OF BLUR DETECTION METRIC

This part explains how the proposed CPBD metric provides better blur detection in the no reference image. It uses concept of JNB[6] in combination with cumulative probability of blur detection (CPBD). It shows great results for all blur types including Gaussian blur & JPEG 2000 blur and across databases as compared to already established metrics. As distortions in the image are higher, the CPBD metric value is supposed to decrease. So multiplicative inverse of these metrics is computed and utilized for analyzing sharpness in the images.

For a given contrast C, the blur detection probability is in the form of psychometric function which is designed as exponential given by,

$$P_{BLUR} = P_{BLUR}(e_i) = 1 - \exp(-|W(e_i)/W_{JNB}(e_i)|^\beta) \dots\dots\dots (1)$$

Where $W(e_i)$ is measured width of the edge e_i , $W_{JNB}(e_i)$ is JNB width. The JNB width relies on contrast 'C' in the neighborhood of edge e_i . The value of β is obtained by means of least squares fitting. The JNB width W_{JNB} is designed as equation [1]:

$$W_{JNB} = 5, \text{ if } C \leq 50 \\ = 3, \text{ if } C \geq 51 \dots\dots\dots (2)$$

Equation (2) will compute just noticeable blur width W_{JNB} depending upon contrast value C.

If contrast is less than equal to 50 then W_{JNB} is taken as 5 otherwise it is taken as 3[6]. If $W(e_i) = W_{JNB}(e_i)$, it gives probability of blur detection $P_{BLUR} = P_{JNB} = 63\%$.

Any image is made up of number of edges depending on intensity values. When viewer sees an image, he comes up with its overall quality due to information in that image is pooled in certain manner. Using Equation(1), we can calculate probability of blur detection for single edge. But any image consists of large number of edges[8]. So it becomes very necessary to formulate a metric to show how information at single edge can be combined together to get single quality score[3]. This forming of edge pixels in single blocks with important edge information and then considering all edge blocks is done using metric which depends on probability summation model. But JNB metric does not consider blur when it is less than JNB. CPBD metric detects blur at the edges at which probability of blur detection is below $P_{JNB} = 63\%$ i.e. CPBD metric detects blur at the edges which is not detected by Just Noticeable Blur (JNB) [6]. The CPBD metric is formed by using normalized histogram of probability of blur detection of edges in whole image. If the image is highly distorted then the spreading of the edges is also higher. So increasing probability of blur detection is used at this edges. The proposed CPBD is related to the percentage of edges where P_{BLUR} is less than P_{JNB} . A larger CPBD value shows sharp image.

Block diagram representing evaluation of CPBD blur metric is shown in Fig. (1). the image firstly undergoes edge detection process. In the proposed work, we are concentrating only on detecting horizontal edges because results have

shown that detecting and considering vertical edges does not provide any improvement in the results. When metric was tested by considering both JNB and CPBD [7] these are the results for Gaussian blur and JPEG-2000 images. So we are considering only horizontal edges. Then 64×64 blocks of image are considered at a time. Then edge information in each block is verified to divide blocks in two types: edge blocks or non-edge blocks. The type deciding factor considered here is following criteria: If number of edges in each block is at least 0.002 of total number of pixels in the block then that block is considered as edge block. Otherwise it is considered as non-edge block. And processing of these smooth blocks is stopped. So the threshold value considered here is T=0.2%. For each edge pixel e_i in an edge block, edge pixels are analyzed and edge width $W(e_i)$ is computed. At the same time, the corresponding JNB edge width $W_{JNB}(e_i)$ is determined using contrast 'C' of the block using(2). Then blur detection probability at edge pixel e_i , $P_{BLUR} = P_{BLUR}(e_i)$, is determined by utilizing Equation (1). Finally a normalized histogram of probabilities is obtained, which is Probability Distribution Function (PDF) of P_{BLUR} . From this PDF of P_{BLUR} , the proposed CPBD metric is evaluated as,

$$\begin{aligned}
 \text{CPBD} &= P(P_{BLUR} \leq P_{JNB}) \\
 &= \sum_{P_{BLUR} = 0}^{P_{BLUR} = P_{JNB}} P(P_{BLUR}) \dots\dots\dots (3)
 \end{aligned}$$

Where $P(P_{BLUR})$ indicates probability distribution function at a given P_{BLUR} . This CPBD metric depends on the concept that at JNB, $W(e_i) = W_{JNB}(e_i)$ which indicates $P_{BLUR} = P_{JNB} = 63\%$.

Thus, when $P_{BLUR} \leq P_{JNB}$ that indicates $W(e_i) > W_{JNB}$. So blur is not detected at the edge. The higher value of $W(e_i)$ edge width means image is highly blurred that is spreading at the edge is higher and hence a highest probability of blur detection at that edge. As discussed, mentioned CPBD metric (3), is related to percentage of edges at which $P_{BLUR} < P_{JNB}$ i.e. to percentage of edges at which blur cannot be detected. So, higher CPBD value shows sharper image regions. Thus, CPBD having highest value as 1.0 indicates quality image with less distortions.

IV. BLOCK DIAGRAM

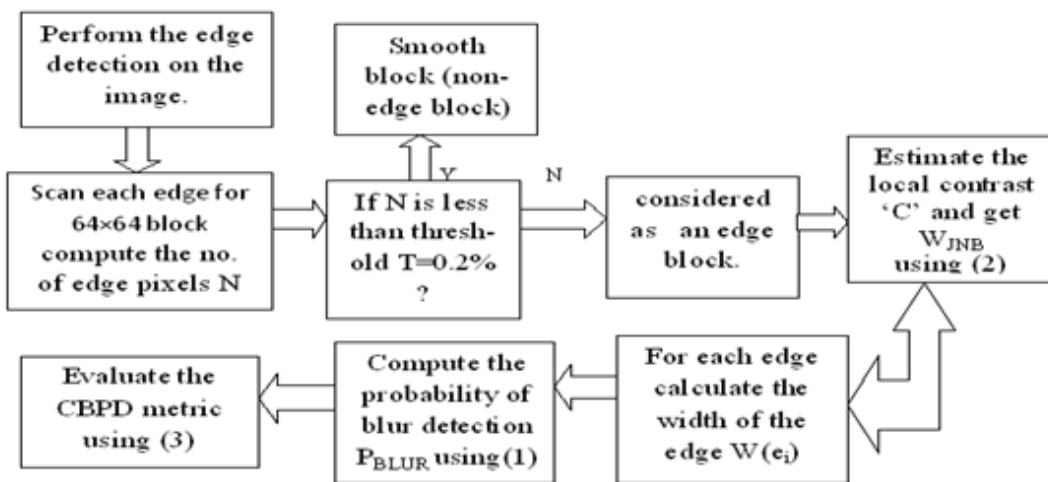


Fig.1. Block Diagram Representing Evaluation Of CPBD Metric.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

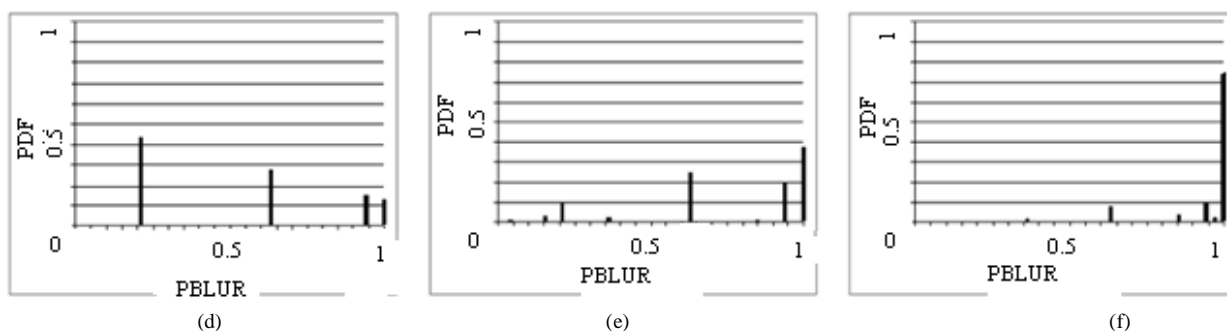
Vol. 5, Issue 8, August 2016

V. PERFORMANCE RESULTS

This section provides idea about analysis of results for proposed CPBD metric. This is done by using different test sets from publically available databases for analyzing metric. It includes different Gaussian blurred and JPEG 2000 compressed images. These images are taken from LIVE[8] and IVC[9] database. The LIVE database includes 29 RGB color images[8]. The images are distorted by using different distortion types : White noise in RGB components bit errors in the JPEG 2000 bit stream, JPEG 2000, Gaussian blur in RGB components. These images are among five types: Bad, Poor, Fair, Good and Excellent. The IVC database[9] consists of 10 reference and blurred images. The images are distorted using JPEG, JPEG2000, LAR coding and blurring. In this database five point scale is used to define quality of the image: 5-imperceptible, 4-perceptible but annoying, 3-slightly annoying, 2-annoying and 1-very annoying. Then Mean Opinion Score (MOS) is computed.

Results are shown to give idea about behavior of proposed CPBD metric. Fig.2 shows performance of CPBD metric for 512x768 Hats image which is from UT Austin LIVE database [8].

Fig.2 (a)-(c) Shows distorted version of image having standard deviation of 0.1, 1.2 and 2.1 respectively. Fig.2(d)-(f) presents probability density function (PDF) related to Fig. 2(a)-(c). The relative commutative distribution function (CDF) are shown in Fig. 2(g)-(i). It can be predicted that if distortion in the image increases, the CPBD value decreases. CPBD values obtained for fig. 2(a)-(c) are: for fig. 2(a) CPBD = 0.6342, for fig. 2(b) CPBD = 0.8942 and for fig. 2(c) CPBD= 0.9458.



International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 8, August 2016

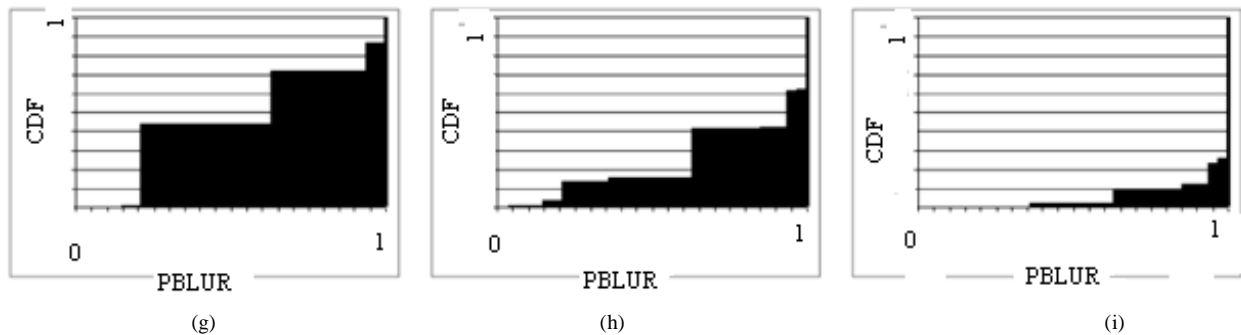


Fig.2(a)-(c)Shows distorted version of image having standard deviation of 0.1, 1.2 and 2.1 respectively. Fig.2(d)-(f) presents probability density function (PDF) related to Fig. 2(a)-(c). The relative commutative distribution function (CDF) are shown in Fig. 2(g)-(i).

TABLE I
COMPARISON OF CPBD VALUE WITH OTHER METRICS FOR LIVE DATABASE CEMETERY 627X482 SIZE IMAGES FOR GAUSSIAN BLUR DISTORTIONS

Metric	Image c	Image b	Image a
CPBD	0.6342	0.8942	0.9458
LPC	0.5985	0.8043	0.8923
JNB	0.5632	0.7725	0.8126

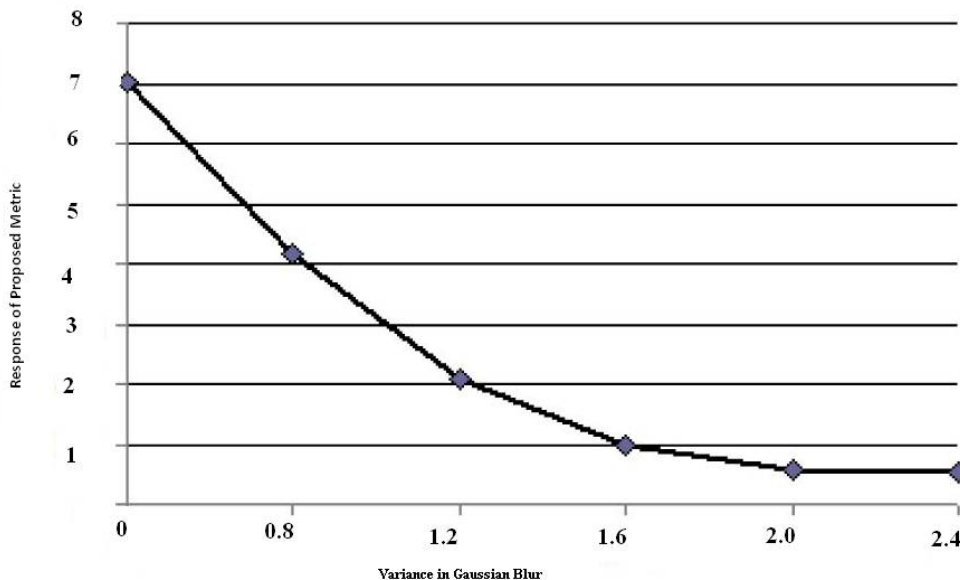


Fig. (3) Monotonic decreasing behavior of proposed CPBD metric for increasing blur (512*768 image)

VI. CONCLUSION

This paper presents CPBD metric for no reference image blur detection. It starts with edge detection in the blocks of entire image and after edge detection it computes probability of blur detection at these detected edges. These probabilities then gives rise to probability density function (PDF) from which final commutative probability of blur detection is estimated. CPBD value lies between 0.0 to 1.0. So if probability of blur increases, CPBD value decreases up to 0.0 and image which have CPBD value equal to 1.0 indicates sharper image. It shows good results for Gaussian

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 8, August 2016

blur and JPEG2000 blur images as compared to already established distortion/blur metrics. This CPBD metric is very useful in medical purpose like Telemedicine.

In future, research on this metric can be done considering detecting blur in videos & 3-D contents by taking temporal & depth factors in consideration.

REFERENCES

- [1] Niranjana D. Narvekar and Lina J. Karam, "No-reference Image Blur Metric Based on the Cumulative Probability of Blur Detection (CPBD)", *IEEE Trans. Image Process.*, vol. 20, no. 9, pp. 2678-2683, Sep. 2011.
- [2] Rania Hassen, Zhou Wang and Magdy Salama, "No reference image sharpness assessment based on local phase coherence measurement", *IEEE international conference on acoustics, speech and signal processing (ICASSP10)*, Dallas, TX, MAR.2010.
- [3] R. Ferzli and L.J. Karam, "A no-reference objective image sharpness based on the notion of just noticeable blur (JNB)", *IEEE Trans. Image Process.*, vol. 18, no. 4, pp. 717-728, Apr.2010.
- [4] L.J. Karam, T. Ebrahimi, S.S. Hemami, T. N. Pappas, R. J. Safranek, Z. Wang and A.B. Weston, "Introduction to the issue on visual media quality assessment", *IEEE Trans. Signal process.*, vol. 3, no. 2, pp. 189-192, Apr. 2009
- [5] R. Hassen, Z. Wang and M. Salama, "No-reference image sharpness assessment based on local phase coherence (LPC) measurement," in *Proc. IEEE Int. Conf. Signal Process.*, pp.2434-2437, Mar. 2009
- [6] Niranjana D. Narvekar and Lina J. Karam, "No-reference Image Blur Metric Based on the Cumulative Probability of Blur Detection (CPBD)", *IEEE Trans. Image Process.*, vol. 20, no. 9, pp. 2678-2683, Sep. 2011
- [7] Rania Hassen, Zhou Wang and Magdy Salama, "No reference image sharpness assessment based on local phase coherence measurement", *IEEE international conference on acoustics, speech and signal processing (ICASSP10)*, Dallas, TX, MAR.2010.
- [8] R. Ferzli and L.J. Karam, "A no-reference objective image sharpness based on the notion of just noticeable blur (JNB)", *IEEE Trans. Image Process.*, vol. 18, no. 4, pp. 717-728, Apr.2010.
- [9] L.J. Karam, T. Ebrahimi, S.S. Hemami, T. N. Pappas, R. J. Safranek, Z. Wang and A.B. Weston, "Introduction to the issue on visual media quality assessment", *IEEE Trans. Signal process.*, vol. 3, no. 2, pp. 189-192, Apr. 2009
- [10] R. Hassen, Z. Wang and M. Salama, "No-reference image sharpness assessment based on local phase coherence (LPC) measurement," in *Proc. IEEE Int. Conf. Signal Process.*, pp.2434-2437, Mar. 2009
- [11] N. D. Narvekar, and L. J. Karam, "A No-Reference Perceptual Quality Metric based on cumulative probability of blur detection," *First International Workshop on Quality of Multimedia Experience-09*, pp. 87-91, July 2009.
- [12] Niranjana D. Narvekar, "Objective no-reference visual blur assessment," *M.S. thesis Dept. Electrical Eng., Arizona State Univ., Tempe*, 2009
- [13] N.G. Sadaka, L. J. Karam, R. Ferzli and G. P. Abousleman, "A no-reference perceptual image sharpness metric based on saliency-weighted foveal pooling," *IEEE Int. Conf. Image Process.*, pp. 369-372, Oct. 2008
- [14] Z. Wang, G. Wu, H. R. Sheikh, E. P. Simoncelli, E. Yang, and A. C. Bovik, "Quality-aware images," *IEEE Trans. Image Process.*, vol. 15, no. 6, pp. 1680-1689, Jun. 2006.
- [15] R. Ferzli and L. J. Karam, "No-reference objective wavelet based noise immune image sharpness metric," *IEEE international Conference on Image Processing*, vol. 1, pp. 405-408, Sept. 2005.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 8, August 2016

BIOGRAPHY

Mr. Rohan Vijay Sonawane.

M.E (VLSI& Embedded Systems) (Appeared).
Dept. Electronics & Tele-Communication Engineering,
Shree Ramchandra College of engineering, Lonikand (Pune),
Maharashtra India.



Prof. K. Sujatha. (Ph.D)

H.O.D.
Dept. Electronics & Tele-Communication Engineering,
Shree Ramchandra College of engineering, Lonikand (Pune),
Maharashtra India.

