iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 4 **Issue:** IV **Month of publication:** April 2016

DOI:

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Block Based Motion Estimation Transmission over Wireless Channels Using Distance Power Adaptation

K.Prasuna[1], M.Padmaja[2]
[1,2]*Assistant Professor, ECE Department*
[1]*Vijaya Institute of Technology for Women, Vijayawada (A.P.)*
[2]*VR Siddhartha College of Engineering,Vijayawada*

Abstract—Block based transmission plays an important role for video transmission in wireless communications. This paper proposes a Distance based Power Adaptation Algorithm (DPAA) for Motion Estimation to improve the motion estimates resulting from 2X2 and 4X4 blocks. The motion estimates are transmitted over AWGN channel using BPSK modulation and the results are compared with the DPAA Algorithm. Performance analysis shows that that optimized RMSE and BER is obtained with DPAA rather than Conventional Power Adaptation Algorithm.
Keyword-: Motion estimation, RMSE, PSNR, BER

I. INTRODUCTION

With the increasing complexity of these communication systems comes increasing complexity in the type of content being transmitted and received. The early content of plain speech/audio and basic black and white cropped images used in early radio and television has developed into high definition audio and video streams; and with the introduction of computers into the mix even more complex content needs to be considered from cropped images, video and audio to medical and financial data. It is very challenging to provide acceptable quality of services as measured by the Mean Square Error (MSE) due to the limitations imposed by the wireless communication channels such as fading and multipath propagation. Techniques are continuously being developed to maximize data throughput and efficiency in these wireless communication systems while endeavoring to keep data loss and error to aminimum. Power Adaptation has been an effective approach to mitigating the effect of fading channels in the quality of signal transmission over wireless channels [1-2]. The use of power in multimedia communications is becoming more and more important and intricate, predominantly when multimedia signal processing is incorporated. Since high power wireless systems are distorted, it is essential to adjust power of the transmitted bits to guarantee signal reliability. Wireless compressed image transmission is important for a variety of applications, from security and surveillance to in-home monitoring. Most existing studies on Power optimization of wireless communications consider error-free bit transmission, where the entire bit stream has to be retransmitted if there is even a single bit error. However, for cropped image transmission applications, there is often a certain tolerance to errors in the received data, as errors in the decoded data become distortion in the DCT compressed image content.

II. PROBLEM FORMULATION

Motion estimation (ME) techniques have been successfully applied in motion compensated predictive coding for reducing temporal redundancies. They belong to the class of nonlinear predictive coding techniques. An efficient representation of motion is critical in order to reach high performance in video coding. ME techniques should on one hand provide good prediction, but on the other hand should have low computational load. The purpose of ME is indeed to globally minimize the sum of these two terms. As acompromise, block matching ME, even though not optimal, has been universally used [1]-[3] in interframe motion compensated (MC) predictive coding since its computational complexity is much lower than optical flow and pel recursive methods. In block based ME image is partitioned into blocks and the same displacement vector is assigned to all pixels within a block. The motion model assumes that an image is usually composed of rigid objects in translational motion. Although the assumption of translational motion is often considered to be a major drawback in the presence of zoom but the block matching technique is able to estimate closely the true zooming motion. And hence the block matching ME results globally in motion fields more representative of true motion in the scene [4-7].

Volume 4 Issue IV, April 2016
ISSN: 2321-9653

The system is a typical binary phase shift keying (BPSK) digital communication system for multimedia transmission. The signal is sampled, quantized and then coded into binary bits for transmission. The transmitted BPSK signal is represented as

$$S(t) = \sum_{k=0}^{\infty}\sum_{i=0}^{M-1}\sqrt{w_{ib_{ki}}}\, g(t-(kM+i)T_b \quad (1)$$

In a BPSK system the received signal is given by

$$Y = x+n \qquad (2)$$

Where $x \in \{-A, A\}$ and $\sigma^2 = N_o$

The bit error probability is

$P_b = Q(\sqrt{2\gamma_b})$ (3)

And the Q-function is given by

$Q(x) = \frac{1}{\sqrt{2\pi}}\int_x^{\infty} e^{-\frac{x^2}{2}}\, dx$ (4)

$$Q(x) = \left[\frac{1}{(1-a)x + a(x^2+b)^{0.5}}\right]\frac{1}{(2\pi)^{0.5}} e^{-\frac{x^2}{2}} \qquad (5)$$

Equation (6) is widely used in Bit error rate calculation.

The Q-function can be described as a function of error function defined over $[0, \infty)$ and is given by

$$\mathrm{erf}(x) = \frac{2}{\sqrt{\pi}}\int_0^x e^{-y^2} dy \quad (6)$$

With $\mathrm{erf}(0) = 0$ and $\mathrm{erf}(\infty) = 1$

$$P_b = Q(\sqrt{2\gamma_b}) (7)$$

$$P_s = 1 - [1 - Q(\sqrt{2\gamma_b})]^2 (8)$$

$$\gamma_s = 2\gamma_b = \frac{A^2}{N_o} (9)$$

Where the Q function is defined as:

$$Q(x) \le \frac{1}{\sqrt{2\pi}}\int_x^{\infty} e^{-\frac{x^2}{2}}\, dx \qquad (10)$$

The Bit Error rate of BPSK is given by

$$Q(z) \le \frac{1}{z\sqrt{2\pi}} e^{-\frac{x^2}{2}} dx \qquad (11)$$

$$P_{s \le} \frac{3}{\sqrt{2\pi\gamma_s}} e^{-0.5\gamma_s} (12)$$

P_b Can be approximated from P_s by P_b as

$$P_b = \frac{P_s}{2} (13)$$

The Bit Error Rate for BPSKsignaling can be calculated by an approximation of symbol error rate using nearest neighbor approximation. The Symbol error probability can be approximated by

$$P_s = 1 - \left[1 - Q\left(\sqrt{2\gamma_b}\right)\right]^2 (14)$$

III. DISTANCE BASED POWER ADAPTATION ALGORITHM(DPAA)

When there are N number of images and M number of bits in a multimedia system, then the powers transmitted by the bits be $P = [P_1, P_2, \dots \dots \dots \dots \dots . . P_M]$ and the respective RMSE's of the bits be $RMSE = [RMSE_1, RMSE_2, \dots \dots \dots . . RMSE_M]$. Let $RMSE_T$ be the target RMSE. For a system with M bits per sample, there are 2M different bits to be transmitted[13].

The probability that ith sample with a decimal value of (i) is reconstructed is given by

$$PD_i = \prod_{k=0}^{M-1} [p_k \vartheta(k) + (1 - p_k) \widetilde{\vartheta(k)}] \qquad (15)$$

Where p_k is the probability that the kth bit is in error.$\vartheta(k)$ is equal to zero if the indices of i and k are same and the value will be equal to 1 if the indices are different. The notation $\widetilde{\vartheta(k)}$] represents the binary inversion of$\vartheta(k)$.[9-12]

The MSE for the above case is calculated as

$$MSE = \frac{1}{\sqrt{2^M - 1}} \sum_{k=0}^{M-1} PD_i \; (16)$$

The probability of the kth bit to be in error for the AWGN case is given by

$$P_k = Q\left(\sqrt{2\frac{E_b}{N_o}(k)}\right) (17)$$

A. Algorithm

1) Initialize number of iterations
2) Initialize number of bits
3) Initialize d_{min}, R, k, n
4) for i = 1 to iterations
5) Initialize power vector to all ones
6) Initialize *PAPRmax*
7) For $j = 1$ to bits
8) if $d_{bb} \le dmin$

$$p(j) = k(d_{min}/R)^n$$

else

p (j) =k(dbb (j)/R)n

end

9) Initialize power step size to ∆P.
10) For i = 1 to iterations
11) Define two bits, R is recipient power and C is contributing power ,
12) For *j = 1* to bits
13) Compute *RMSE*.
14) Update power of all the bits using

$$P_i^{n+1} = RMSE_i^n x P_i^n \tag{18}$$

Where

$$RMSE_i^n = \frac{MAX\,(RMSE_i^n, RMSE_T)}{RMSE_i^n} \tag{19}$$

P_i^{n+1}=Power allocated in the n+1 state
P_i^n = Power allocated in the n state
$RMSE_i^n$=Root mean square error of ith bit in n_{th} iteration
$RMSE_T$ =Target Root Mean Square Error
15) Calculate the maximum power of each bit.
16) Repeat the same procedure (8) and (9) above but with the Contributor bit C incremented by one until all least significant bits are used.
17) Calculate the maximum MSE.
18) Plot Energy per Bit versus RMSE,BER and PSNR.

IV. NUMERICAL RESULTS AND CONCLUSIONS

Fig.1 shows the Full Search block matching algorithm. This method was used for motion estimation with block size 2x2 and 4x4 maximum with a displacement 3 and frame by frame transmission. The sequences are generated with block size 2x2 and 4x4 with motion estimation by encoding blocks frame by frame. Each frame is transmitted through AWGN channel and the Distance based power adaptation algorithm is applied. The frames are decoded and the corresponding parameters Root Mean Square Error(RMSE),Peak Signal to Noise Ratio(PSNR) and Bit ErrorRate(BER) are tabulated. In this Process, Binary phase shift keying is used and full block based motion estimation method is used.RMSE, PSNR, BER values of video Transmission using Conventional Power Adaptation Algorithm and Distance Power Adaptation Algorithm for 2x2 and 4x4 block size motion estimation are tabulated in Tables I,II,III and IV. Table V and VI shows the Variance and Entropy values of 2x2 and 4x4 block size motion estimation and Fig.8 shows the convergence of entropy. Fig.2,3,4 and 5 shows 2x2 and 4x4 block sizes of motion compensated Prediction with overlay of motion vectors, Frame Difference (fd)and motion compensated frame difference (mcfd).Fig.6 and Fig.7 shows the plots of RMSE and BER over AWGN using Distance Power Adaptation Algorithm and Conventional power Adaptation Algorithm of 2x2 and 4x4 block size motion estimation.

The performance shows that Distance based PowerAdaptation Algorithm gives better performance in terms of optimized RMSE and BER compared with Conventional Power adaptation Algorithm.In Conventional Algorithm, Error is more compared with Proposed Algorithm.The Bit error rate shows that higher gains can be achieved using this proposed method rather than conventional algorithm. Themethod shows better results compared with power allocation methods proposed by Akram Bin Sediq and Mohamed El-Tarhuni [12]. A better performance measure in such cases is the root-mean square error (RMSE) rather than the BER because bits transmitted by the system do not carry the same amount of information about the message. In this paper BER also shows better performance measure over conventional Power adaptation algorithm.

Table I: RMSE, PSNR, BER values of Image Transmission using Distance Power Adaptation Algorithm for 2x2 block size motion estimation

Eb/No	RMSE	PSNR	BER
0	0.4694	54.7344	0.2203
1	0.4360	55.3755	0.1901
2	0.4004	56.1148	0.1603
3	0.3606	57.0238	0.1300
4	0.3186	58.0996	0.1015
5	0.2711	59.5029	0.0735
6	0.2134	61.5822	0.0455
7	0.1409	65.1888	0.0198
8	0.0602	72.5775	0.0036
9	0.0084	89.6395	0.0001
10	0	Inf	0

Table II: RMSE, PSNR, BER values of Image Transmission using Conventional Power Adaptation Algorithm for 2x2 block size motion estimation

E_b/N_o	RMSE	PSNR	BER
0	0.5389	53.5348	0.2904
1	0.5380	53.5499	0.2894
2	0.5379	53.5510	0.2893
3	0.5376	53.5557	0.2890
4	0.5381	53.5481	0.2895
5	0.5382	53.5459	0.2897
6	0.5377	53.5533	0.2892
7	0.5388	53.5361	0.2903
8	0.5377	53.5544	0.2891
9	0.5378	53.5520	0.2893

Table III: RMSE, PSNR, BER values of Image Transmission using Conventional Power Adaptation Algorithm for 4x4 block size motion estimation

$\mathbf{E_b/N_o}$	**RMSE**	**PSNR**	**BER**
0	0.5241	53.7766	0.2747
1	0.5238	53.7808	0.2744
2	0.5238	53.7820	0.2743
3	0.5235	53.7859	0.2741
4	0.5236	53.7849	0.2741
5	0.5241	53.7765	0.2747
6	0.5241	53.7771	0.2746
7	0.5236	53.7854	0.2741
8	0.5236	53.7846	0.2742
9	0.5238	53.7821	0.2743
10	0.5232	53.7909	0.2738

Table IV: RMSE, PSNR, BER values of Image Transmission using Distance based Power Adaptation Algorithm for 2x2 block size

Volume 4 Issue IV, April 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

motion estimation

Eb/No	RMSE	PSNR	BER
0	0.4537	55.0299	0.2058
1	0.4208	55.6823	0.1771
2	0.3855	56.4445	0.1486
3	0.3468	57.3635	0.1203
4	0.3048	58.4844	0.0929
5	0.2575	59.9476	0.0663
6	0.1989	62.1916	0.0396
7	0.1288	65.9635	0.0166
8	0.0538	73.5449	0.0029
9	0.0069	91.4394	0.0000
10	0	Inf	0

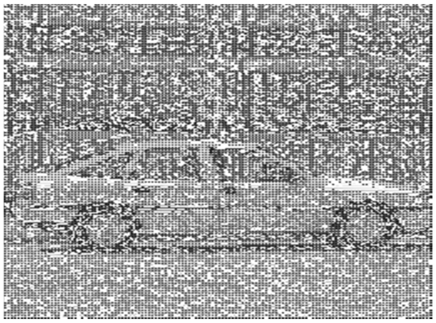

Fig.2 Image of block size 2x2 showing motion compensated Prediction with overlay of motion vectors

Fig.3 Image showing Frame Difference of block size 2x2

Fig.4 Image showing Frame Difference of block size 4x4

Table V: Variance and Entropy values of4x4block size motion estimation

Volume 4 Issue IV, April 2016
ISSN: 2321-9653
International Journal for Research in Applied Science & Engineering Technology (IJRASET)

Frame	Variance			Vector
	original	fd	mcfd	entropy
2	1405.76	259.49	49.87	2.94
3	1401.37	215.56	58.04	2.99
4	1385.61	274.35	63.31	3.01
5	1378.71	318.26	55.51	2.97
6	1373.24	323.39	55.99	2.99
7	1372.78	337.46	57.32	2.98
8	1365.19	260.50	53.15	2.97
9	1370.82	208.92	50.24	2.99
10	1371.69	227.49	56.73	3.01

Table VI: Variance and Entropy values of4x4block size motion estimation

Frame	Variance			Vector
	original	fd	mcfd	entropy
2	1405.76	259.49	73.38	2.97
3	1401.37	215.56	85.96	3.07
4	1385.61	274.35	93.78	3.04
5	1378.71	318.26	87.54	3.06
6	1373.24	323.39	87.05	3.06
7	1372.78	337.46	85.70	3.06
8	1365.19	260.50	82.60	3.06
9	1370.82	208.92	83.03	3.03
10	1371.69	227.49	88.60	3.10

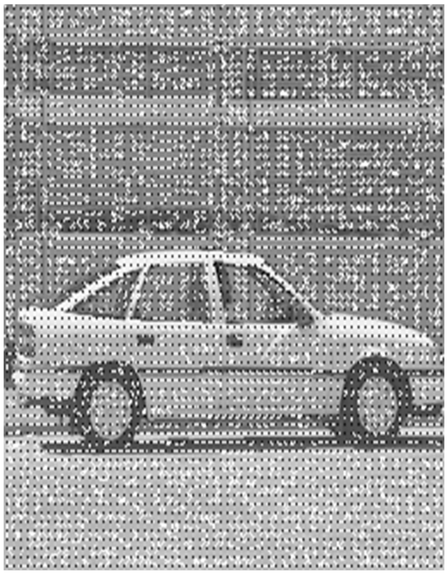

Fig.4 Image of block size 4x4 showing Motion compensated Prediction with Overlay of motion vectors

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

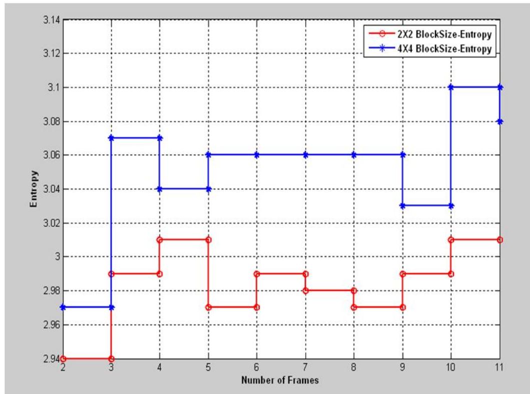

Fig.5 Variance and Entropy step variations of2x2 and 4x4block size motion estimation

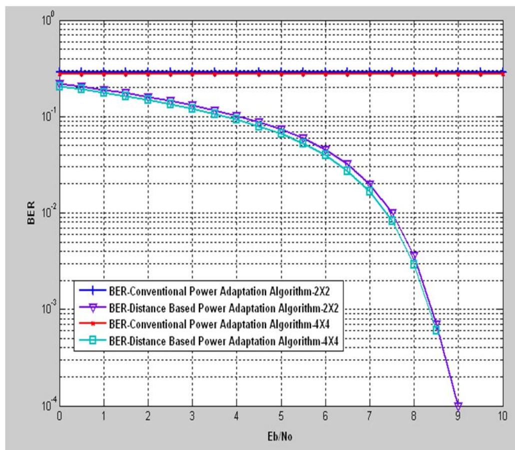

Fig.6 Plot showing BER over AWGN usingDistance Power Adaptation Algorithm and Conventional power Adaptation Algorithm of2x2 and 4x4 block size motion estimation

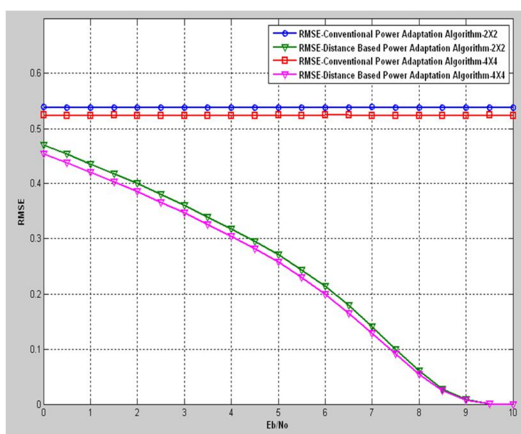

Fig.7 Plot showing RMSE over AWGN using Distance Power Adaptation Algorithm and Conventional power Adaptation Algorithm of2x2 and 4x4 block size motion estimation

REFERENCES

[1] Nakaya and H. Harashima, "Motion compensation based on spatial transformation," IEEE Transon Circuits and Systems for Video Technology, Vol. 4, No. 3, pp. 339-356, Jun. 1994.

[2] P. Cicconi and H. Nicolas, "Efficient region-based motion estimation and symmetry oriented segmentation for image sequence coding," IEEE Trans. on Circuits and Systems for Video Technology, Vol. 4, No. 3, pp. 357-364, Jun. 1994.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)

[3] Y. Yokoyama, Y. Miyamoto and M. Ohta, “Very low bit rate video coding using arbitrarily shaped region-based motion compensation,” IEEE Trans. on Circuits and Systems for Video Technology, Vol. 5, No. 6, pp. 500-507, Dec. 1995.
[4] T. H. Meng, A. C. Hung, E. K. Tsern, and B. M.Gordon, “Low-power signal processing systemdesign for wireless applications,” IEEE Pers. Commun. , pp. 20–31, June 1998.
[5] S. Appadwedula, M. Goel, N. R. Shanbhag, D. L. Jones, and K. Ram-chandran, “Total system energy minimization for wireless cropped image trans-mission,” J. VLSI Signal Processing Syst. , vol. 27, no. 1/2, pp. 99–117,Feb. 2001.
[6] Q. Zhang, Z. Ji, W. Zhu, and Y. Q. Zhang, “Power-minimized bit allocation for video communication over wireless channels,” IEEE Trans. Circuits Syst. Video Technol., vol. 6, pp. 398–410, June 2002.
[7] Technical specification group radio access network: physical layer –general specification, 3GPP, Release 6,December 2003, www.3gpp.org.
[8] J. Proakis, Digital Communications, 4th ed., McGraw-Hill,2001.Talukder, K.H. and Harada, K., A Scheme of Wavelet Based Compression of 2D Cropped image, Proc. IMECS, Hong Kong, pp. 531-536, June 2006.
[9] Ahmed, N., Natarajan, T., and Rao, K. R., Discrete Cosine Transform, IEEE Trans. Computers, vol. C-23, Jan. 1974, pp. 90-93.
[10] Pennebaker, W. B. and Mitchell, J. L. , Still Cropped image Data Compression Standards, Van Nostrand Reinhold, 1993. Press, 1990.
[11] Wallace, G. K., The Still Picture Compression Standard , Comm. ACM, vol. 34, no. 4, April 1991, pp. 30-44.
[12] Power Allocation and Coding for Image Transmission over Wireless Channels, Akram Bin Sediq and Mohamed El-Tarhuni
[13] Z. Ji, Q. Zhang, W. Zhu, and Y. Q. Zhang, “Joint Power control and source-channel coding for video Communication over wireless Networks,” in Proc. IEEE VehicularTechnology Conf., Oct. 2001, Pp.1658–166