

A Review Study Uep Method Using Rpcp Codes And Hierarchical Modulation For Optimal Digital Transmission

Allah-ngoi Yorbana¹, Dr. R. S. Kawitkar²

¹PG student (communication networks) Department of E&TC, Sinhgad College of Engineering Pune (India).

Email: dydallah@gmail.com

²Professor, Department of E&TC & Professor Convener (student activities of college), Sinhgad College of Engineering Pune (India).

Email: rskawitkar.scoe@sinhgad.edu

ABSTRACT

Often unequal error protection (UEP) schemes most based on protecting video data parameters with unequal rates or levels according to their sensitivities to errors. While transmitting source-encoded data, not all information bits are equally important, due to the different sensitivity of the source decoder to errors. Unequal Error Protection mainly works on allocating coding redundancy depending on the importance of the information bits. In many applications of digital transmission (video, images, voice and data), the importance of different bits in the input sequence of the channel encoder often varies and certain blocks of the sequence need higher protection level than other blocks, when the sequence is transmitted wirelessly. We present in this paper some UEP combined strategies used to improved transmission of wireless video surveillance over wireless channels.

Keywords: UEP, wireless video surveillance transmission, RCPC (Rate-Compatible Punctured Convolutional) code, Error feedback rounding, hierarchical modulation.

I- INTRODUCTION

Our contribution in this paper is a set of results, identifying the performance limits and optimal coding strategies, using UEP strategies to ameliorate the transmission of video from transmitter to the receiver side wirelessly. In telecommunication, a convolutional code is a type of error-correcting code (EEC) that generates parity symbols via the sliding application of a Boolean polynomial function to a data stream. Usually, wireless channels generate a high number of errors which perturb complex multimedia applications (image or video transmission). Designing a suitable system for image transmission over wireless channel remains a major issue for these above reasons.

As explain in [3] in wireless video surveillance systems, each source node is usually equipped with one or more cameras, a microprocessor and/or the storage unit, a transceiver, and the power supply. The basic functions of each node include video capture, video compression and data transmission. The process of video analysis for different surveillance purpose is performed either by the sender or by the receiver, depending on their computational capability. The remote control unit at the receiver's end can also provide some useful information feedback to the sender in order to better serve the surveillance purpose. Figure 1 illustrates the main functional unit of a video surveillance system.

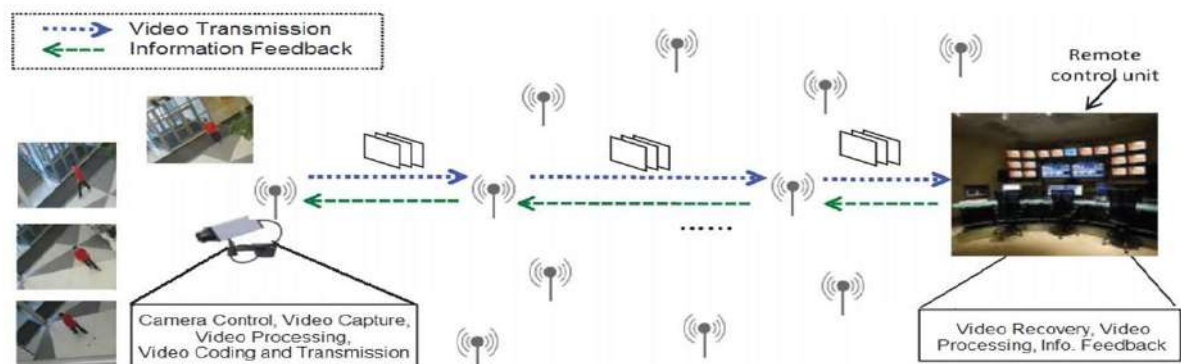


Fig.1: wireless video surveillance [3]

II- DIGITAL VIDEO PROCESSING: ROUND CONSIDERATIONS

When two 8-bit value are multiplied together, a 16-bit result is generated. At some point, a result must be rounded to some lower precision (for example 16-bits to 8 bits or 32 bits to 16 bits) in order to realize a cost effective hardware implementation. There are several rounding techniques such as demonstrate in [16] among these techniques 3 are:

- Truncation: truncation drops any fractional data during each rounding operation. As resulting, in few operations, a significant error may be introduced. This may result in contours being visible in a area of solid colours for instance
- Conventional rounding: conventional rounding use the fractional data bit to determine whether the round up or round down. If the fractional data is 0.5 or greater, rounding up should performed-positive numbers should be more made positive and negative numbers should be made more negative. If the fractional data is less than 0.5, rounding down should be performed-positive numbers should be made less positive and negative number should be made less negative.
- Error feedback rounding: It follows the principle of “never throw anything away”. This is accomplished by storing the residue of a truncation and adding it to the next video sample. This approach substitutes less visible noise like quantized errors in place of contouring effects caused by simple truncation. An example of an error implementation is shown in figure 2. In the example, 16bits are reduced to 8 bits using error feedback.

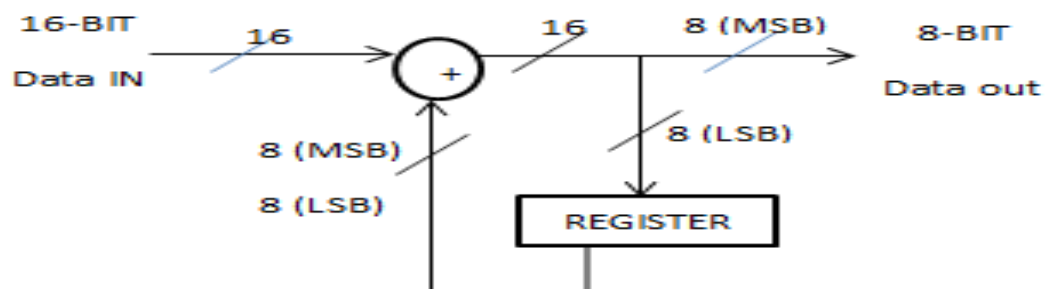


Fig.2: error feedback rounding [8]

III- BASIC PRINCIPLE OF RCPC

The main advantages of RCPC code are resumed in a following table.

Table: performance of RCPC compared to other error control system

	RCPC system	Ritual error control coding system
Channel condition	Change according to the source and channel	Fixed
Correction capability	Change according to the source and channel	Adapt to average or worst
Code rate	Using punctured table to provide flexibility	Match to specific

It has clearly explain the mechanism of RCPC coding in [18], if we have nP encoded bits and l encoded bit deleted (punctured) and not transmitted. Therefore P information bits are mapped to $nP-l$ code bits. So, the code rate is increased from $R=1/n$ to

$$R_{\text{punc}} = \frac{P}{nP-l} \quad \left(> \frac{1}{n} = R\right)$$

$L < (n-1)P$ must be valid to guarantee a code rate smaller than 1 to be able to reconstruct the information bits from encoded bits. P is called Puncturing period and the rate $1/n$ is called Mother code. The positions of encoded bits to be punctured are fixed in a puncturing pattern. With the

increasing of P nearly all code rate between $1/n$ and 1 can be achieved. The RCPC encoder for three exemplary code rates is shown in the figure 3.

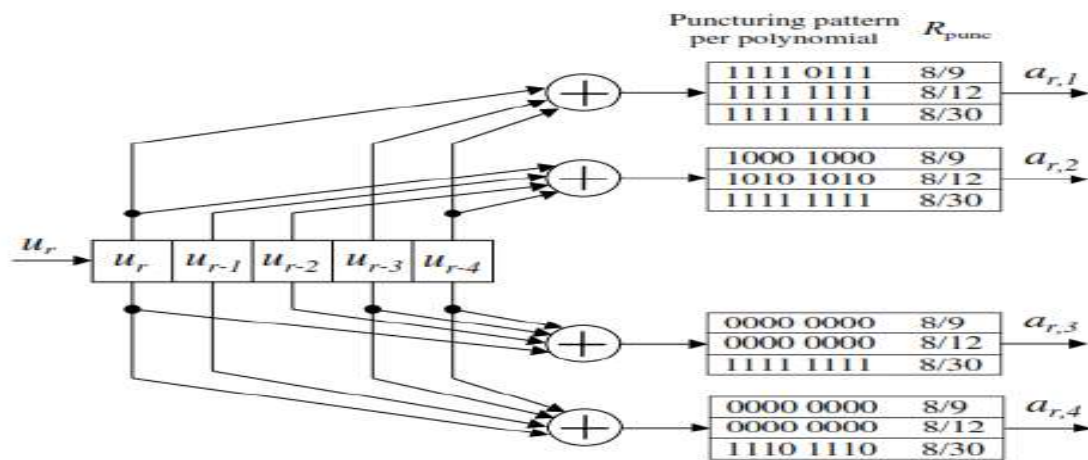


Figure 3: RCPC encoder with three exemplary code rate (rate $1/4$, $m=4$ and $P=8$) [9]
 m = memory length

Many application of the RCPC are discussed in [9] Here we have chosen to present the two main that we think it's useful for our review.

- Transmission channels with varying quality where the code rate is adapted by an ARQ (automatic repeat-request) method (if a feedback channel is available as in figure 1) according to the channel properties. Similarly the punctured code is used for good channels and only if the channel quality is deteriorated the punctured position are transmitted as well to raise the correctability.
- At the data source where the many bits within a frame have varying importance and therefore require a varying error protection too. This is what exactly is called UEP coding.

The following diagram in figure 4 explains why people said that Convolutional codes are computer search methods are not constructed by analytical methods but by trial and error methods. Convolutional encoders do not transform information words into code words block by block, but transform the whole sequence of information bits into a sequence of encoded bits by convolving the information bits with a set of coefficients.

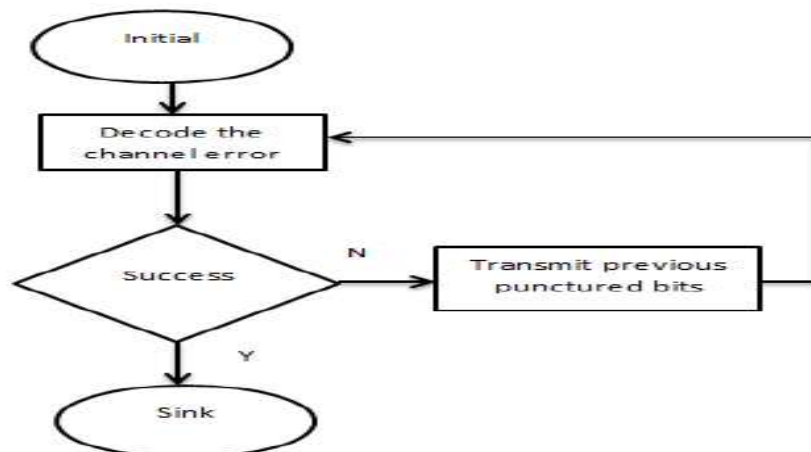


Fig.4: RCPC rule

IV- HIERARCHICAL MODULATION

One most known technique for optimizing using UEP, is Hierarchical modulation. To provide unequal transmission reliability for high priority (HP) and low priority (LP) bits. In [4] several

hierarchical constellations, where the hierarchical parameter adjusts the distances of the symbol points in the constellation. In the same review they have considered the hierarchical parameter α as shown in Figure 5, is the ratio of the distances of the symbols to the origin on one side of the constellation. from one constellation to another, they change α so that HP bits and LP bits will have different error probabilities. Hierarchical 16-QAM (H-16QAM) and hierarchical 64-QAM (H-64QAM) are simple extensions to H-4PAM and H-8PAM, respectively, by considering in-phase and quadrature components as two independent constellations. [7] .

Often in the study of modulation people constrain the average bit energy E to be the same for any modulation parameter here α . In [4] the author said the main objective of hierarchical modulation combined with progressively compressed signals is common to systems and he consider hierarchical modulation and progressive image layers encoded using an adaptive discrete cosine transform. Hierarchical modulation is used without channel coding in wireless relay networks and is shown to yield good unequal protection capability. Another study in the same review has briefly considers both hierarchical modulation and channel coding to provide UEP for two layer video transmission. Unequal protection is achieved by one of the UEP mechanisms in the channel encoder while respecting the delay limitations of the transferred video. It's shown that combining hierarchical modulation and packetization can optimize and improve the transmission scenario.

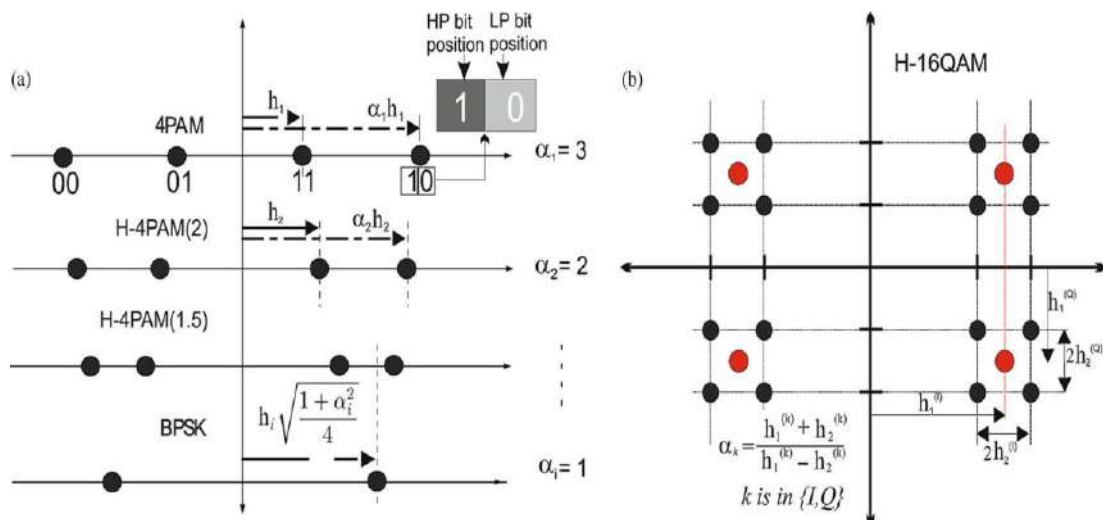


Fig.5: Fig. 1. Hierarchical modulation. (a) 4PAM ($\alpha_1=3$,top),H-4PAM[$\alpha_2 = 2$, $\alpha =1.5$, middle two)], and binary phase-shift keying to which it collapses when $\alpha_i=1$ (bottom). (b) Hierarchical 16QAM (H-16QAM) can be considered as two independent H-4PAM signaling as the in-phase and quadrature components of the original constellation. E constant across all constellations.

V- SYSTEM OVERVIEW

The region of interest video coding is usually used to improve the quality of important areas in a video. Using UEP coding techniques on some communication patterns can be preserved without immolating the bandwidth. In noisy communication environments such as cellular mobile channels, it's not sure that the decoded video at the receiver end preserves the vital information. In the strategy, depending on the source encoder, different code can be used here we have choose RCPC codes because it's the most adaptable with UEP. As for error protection and according the application specific Error correcting code (ECC) is applied. In this paper we present a technique of UEP association with hierarchical modulation in other to provide the more reliable technique for video encoding for wireless transmission. Foreground packets are protected with a stronger error correction code than background packets. The technique present in [4] look same as the same we shown and it improves to save some channel capacity for encoding at a better quality.

Hierarchical modulation is coupled with a packetization/ combining with UEP strategy and an efficient channel encoder consisting of a cyclic redundancy check outer code concatenated with an inner rate-compatible punctured convolutional coder as we are using RCPC as shown in figure 6. All video is process through fading channel and in wireless systems, fading may either be due to multipath propagation, referred to as multipath induced fading, or due to shadowing from obstacles affecting the wave propagation, sometimes referred to as shadow fading. Same systems associated with the performance of RCPC code are studied in [10],[11] [1]. And these effects cause a serious damaged to the video that's why some decoding and encoding are introduced. Most the study of UEP strategy people contrast the Probability of error for a particular signalling scheme for a function of the signal to noise ratio(SNR) at the receiver input and the data rate. Practically to reduce the probability of error we used to use error control coding.

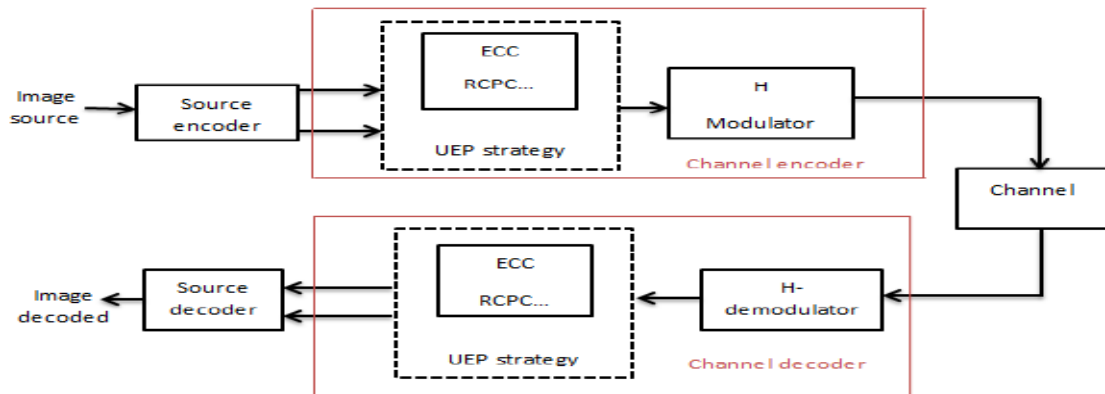


Fig.6: A generalized block diagram of the proposed UEP technique

VI- RESULT

Many researches [8],[9],[13],[16] have proven the use of UEP strategies combining with other strategies. In [1] two techniques the traditional unequal error protection (T- UEP) technique is the most popular they have consider a MPEG4 as a source encoder which is most used today, which can protect the different parts in a MPEG4 video packet (VP) with different channel coding rates based on rate compatible punctured convolutional codes shows that the improvement for decoded video quality after transmission over wireless channels when the channel performance is very poor.

In [2] efficient Error correcting codes are used with the combination of UEP scheme and it shows that it performs by making use of the video error propagation model. Using UEP strategies plus some error correcting code and modulation has been shown in [2] that in terms of average PSNR (Peak signal-to-noise ratio). It results our proposed UEP in a much better reconstructed video quality, especially when the channel SNR is low. Like in the figure 7 shows the results of some proposed UEP strategies associating some error control code and modulation techniques in channel at both transmitter and receiver side.

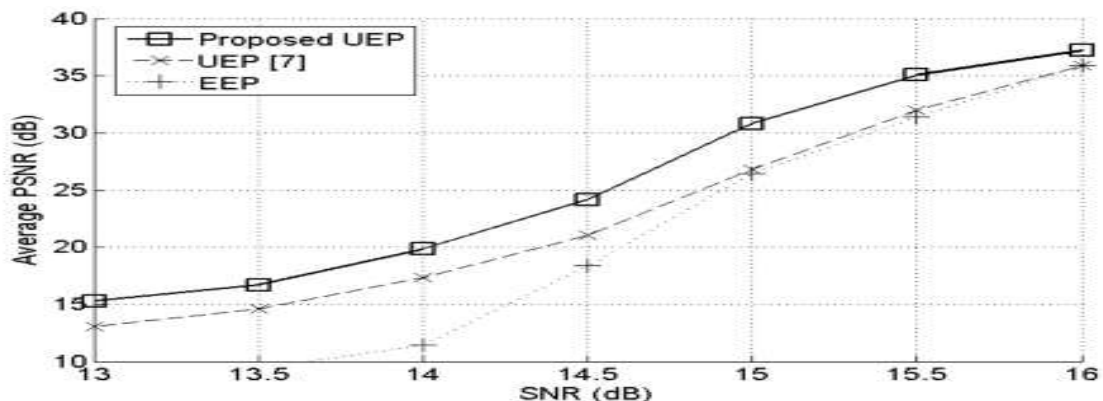


Fig.7: Average PSNR performance of the combined UEP scheme video sequence, in comparison with the simple Error protection methods. [2]

Using UEP strategies in [5] used for optimizing the transmission of JPEG2000 coded images over a MIMO quasi-static Rayleigh fading channel, based on this idea, a selective packet error protection scheme all the data packets lead to a significant increase of the image quality.

- The main goal for error control coding is to apply for real world channel.
- With RCPC codes, we can model channel in a more general way, considering time varying.
- Using UEP techniques plus RCPC we can both narrow down BER and improve efficiency as shown in figure 8.

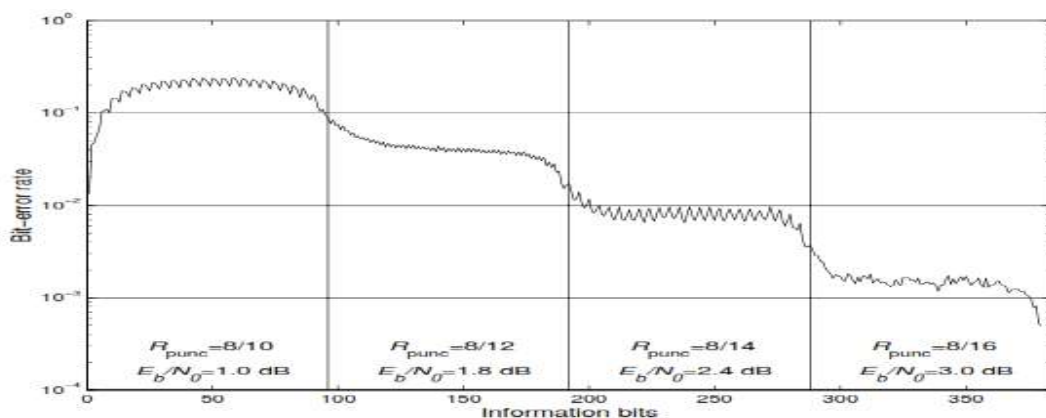


Fig.8: Performance of an RCPC code with four code rates [9]

VII- CONCLUSION

We have shown that different UEP methods can be combined to provide enhanced progressive source transmission using efficient combining strategies. Specifically, a packetization methodology that is coupled with both hierarchical modulation and ECC is considered. It is shown in this study that the different UEP methods can judiciously be combined to provide enhanced reliability for the transmission of the progressive source. After applying it, the decoded video quality can be improved significantly after transmission over noisy wireless channels.

VIII- ACKNOWLEDGMENT

I am indeed thankful to my guide Dr. R.S Kawitkar sir for his able guidance to complete this paper. Extend my special thanks to Head of the Department of Electronics and Telecommunications Dr. M. B. Mali who extended the preparatory steps of this paper-work. I am also thankful to the Principal Dr. S. D. Lokhande, Sinhgad College of Engineering, for his valued support and faith on me.

REFERENCES

Journal papers:

- [1] Bo YAN; Kam Wing NG, "An Improved Unequal Error Protection Technique for the Wireless Transmission of MPEG-4 Video" DOI: 10.1109/ICICS.2003.1292505, IEEE Conference: Information, Communications and Signal Processing, 2003 and the Fourth Pacific Rim Conference on Multimedia. Proceedings of the 2003 Joint Conference of the Fourth International Conference on, Volume: 1.
- [2] Yoong Choon CHANG, Sze Wei LEE and Ryoichi KOMIYA "An Efficient FEC Allocation Algorithm for Unequal Error Protection of Wireless Video Transmission" IEEE International Conference on Advanced Information Networking and Applications, 2009.
- [3] YUN YE, SONG CI, "Wireless Video Surveillance: A Survey", Access, IEEE (Volume:1). Page(s): 646 – 660, ISSN : 2169-3536, September 2013.

- [4] W. HAMIDOUCHE, C. OLIVIER, M. BABEL, O.DEFORGES, Hervé BOEGLIN, Pascal LORENZ; "LAR image transmission over fading channels : A hierarchical protection solution ", The Second International Conference on Communication Theory, Reliability, and Quality of Service, Jul 2009, Colmar, France. pp.1-4. <hal-00373284>, HAL Id: hal-00373284.
- [5] Rebeca Colda, Clency Perrine, Jean-Pierre Cances, Rodolphe Vauzelle, Tudor Palade; "Content-Based Image Unequal Error Protection Strategies for an Open Loop MIMO System" *Int. J. Communications, Network and System Sciences*, 2012, 5, 72-80
- [6] H. Kodikara Arachchi W.A.C. Fernando S. Panchadcharam W.A.R.J. Weerakkody. "UNEQUAL ERROR PROTECTION TECHNIQUE FOR ROI BASED H.264 VIDEO CODING", IEEE conference on Electrical and Computer Engineering, 2006. Canadian Conference : . CCECE '06, Ottawa, Ont, May 2006,Page(s):2033 – 2036
- [7] Suayb S. Arslan, Pamela C. Cosman, and Laurence B. Milstein, "Coded Hierarchical Modulation for Wireless Progressive Image Transmission" *IEEE TRANSACTIONS ON VEHICULAR TECHNOLOGY*, VOL. 60, NO. 9, NOVEMBER 2011.
- [8] GIROD, B., FARBER, N., "Feedback-Based Error Control for Mobile Video Transmission," *Proceedings of the IEEE, Special Issue on Video Transmission for Mobile Multimedia Applications*, Vol. 87, No 10. October, pp. 1707–1723, 1999
- [9] N. MATOBA AND S. YOSHIDA, "Still image transmission using unequal error protection coding in mobile radio channel," *Electron. Commun. Jpn.*, vol. 79, no. 4, pp. 75–85, 1996.
- [10] A. SAID AND W. A. PEARLMAN, "A new fast and efficient image codec based on set partitioning in hierarchical trees," *IEEE Trans. Circuits Syst. Video Technol.*, vol. 6, no. 3, pp. 243–250, Jun. 1996
- [11] YASUDA Y., KASHII K., HIRATA Y., "High-Rate Punctured Convolutional Codes for Soft Decision Viterbi Decoding", *IEEE Transactions on Communications* begacy, pre - 19S8] , Volume: 32 Issue: 3 , Mar 1984, Page(s): 315 -319.
- [12] A. ALBANESE, J. BLOMER, J. EDMONDS, M. LUBY, AND M. SUDAN, "Priority encoding transmission", *IEEE Trans. Inform. Theory*, vol. 42, pp. 17371744, Nov. 1996.
- [13] A. R. Calderbank and N. Seshadri, "Multilevel codes for unequal error protection," *IEEE Trans. Inf. Theory*, vol. 39, no. 7, pp. 1234–1248, Jul. 1993.
- [14] J. LU, A. ANNAMALAI JR., AND D. R. VAMAN, "REDUCING SIGNAL DISTORTION DUE TO TRANSMISSION ERROR VIA MULTI -RESOLUTION DIGITAL MODULATIONS", *WIRELESS TELECOMMUNICATIONS SYMPOSIUM*, APRIL 2008, PP 360- 369.
- [15] G. SHERWOOD AND K. ZEGER, "ERROR PROTECTION FOR PROGRESSIVE IMAGE TRANSMISSION OVER MEMORYLESS AND FADING CHANNELS," *IEEE TRANS. COMMUNICATIONS*, VOL. 46, NO. 12, PP.1555-1559, DECEMBER 1998.

Reference books:

- [16] "VIDEO DEMYSTIFIED" a Handbook for the Digital Engineer, ELSEVER publication, 5th Edition, by Keith Jack . page 192-193
- [17] "Fundamentals of Convolutional Coding" Rolf Johannesson, Kamil Sh. Zigangirov ISBN: 978-0-7803-3483-0 March 1999, Wiley-IEEE Press,(chapter 9)