MEDICAL IMAGE TRANSMISSION WITH DIVERSITY EQUAL GAIN COMBINING

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ABSTRACT

This paper describes a simulation of the medical image transmission system with diversity equal gain combining method on wavelet domain. Diversity equal gain combining methods is used to combat errors during medical image transmission on wireless channels. The use of Reed Solomon channel coding is to recover errors from transsmitted medical image. The result shown that diversity equal gain combining method can be improved significantly the performance of medical image transmission

1. INTRODUCTION

Among the multimedia information, the use of image become one of the important features and has been widely use in various applications such as internet, medical image, distance security camera, MMS (Multimedia Messaging Service) and other applications (2). It indicates that the use of image transmission system wirelessly is more desire and keeps growing. Technology in telecommunication is growing rapidly specially on wireless communication (11). It supported by the growing of portable communication technology that make it possible to exchange the multimedia information (data, voice image and video) where it becomes more popular and more desire.

On transmission over wireless channel, there are cases that can cause the degrade quality of information: noise and fading(5). The disturbance can cause the wrong in receiving information on receiver. The occurrence of disturbances is random and unpredictable. It needs a technique to improve the quality of signal on receiver.

Beside that, the transmission over wireless channel has limitation bandwidth, while image tends to have big capacity. It can cause the ineffective use of bandwidth (8). To overcome the problem, it needs a technique to reduce number of data in image without loosing the important data that appropriate with human visual characteristic.

The research proposed here referred to compression technique (1). For selection combining techniques referred to method proposed (6), but channel model used in this research is fading distribution rayleigh and noise which has normal distribution gaussian (9).

Several methods for image transmission over wireless channels had been done such as Liane C Ramac and Pramod K Varshney proposed *A Wavelet Domain Diversity Method for Transmission of Images over Wireless Channels*(6) that used diversity techniques on domain wavelet to get the good reconstruction image. In this image transmission, two-state Gilbert-Elliott channel (3),(4) was used. P G Sherwood and K Zeger in their journal *Error Protection for Progressive Images Transmission over Memoryless and Fading Channels (*7) used data protection technique during transmission, and also Nikolaos Thomos, Nikolaos V Boulgouris, and Michael G Strinzis in their journal *Wireless Image Transmission Using Turbo Codes and Optimal Unequal Error Protection* (10) used *Turbo Codes* to protect image during transmission

2. BASIC THEORY

The process of diversity combining use two diversity channels, by implementing error correction with interleave bit stream binary 100 bit in row and grouped bit stream to blocks. The coding method with interleaving and RS channel coding for a given data block. Blocks are transmitted by rows and then interleaving the blocks by coloum. Diversity combining method uses the basic of combination block on wavelet domain. The received bit stream from diversity channel that uncorrelated are divided to L blocks and compare to block by block. The diversity rule used is based on the dividing block. (6)

Diversity Equal Gain Combining Algorithm

Algorithm of this diversity is based on block choosing of bit *b(l)*, from one bit stream, it is based on the characteristic of wavelet transformation, and this rule can be defined as follow:

On the receiver, this system is designed with the algorithm of diversity equal gain combining technique by using 2 diversity antennas to correct the error of information signal during transmission. Algorithm from Diversity Equal Gain Combining technique is explained as follows:

Signals that passed on AWGN channel and Rayleigh Fading will get error. It caused error of received information on receiver. Diversity equal gain combining technique is used to reduce the error. Two diversity antennas on receiver are used to receive signal from two channels of multipath fading

+ AWGN that uncorrelated each other. Two uncorrelated signals from two diversity antennas become the input for the block of diversity EGC (*Equal Gain Combining*). Both signals will co-phase to be added up without using the weight. The output from block of diversity Equal Gain Combining is determined by (Baharuddin, 2005). :

$$y(t) = \sum_{i=1}^{M} e^{-j\theta_i} r_i(t) \quad (1)$$

where $r_i(t)$ is the received of equivalent signal lowpass, it formulated as follows (Baharuddin, 2005):

$$r_i(t) = A_i e^{j\theta_i} s(t) + z_i(t) \quad (2)$$

with $s_i(t)$ is the equivalent signal lowpass that send by transmitter and $z_i(t)$ is AWGN. So, resulted signal of *diversity equal gain combining* is formulated as follows (Baharuddin, 2005). :

$$y(t) = \left(\sum_{i=0}^{M} A_i \right) s(t) + \sum_{i=0}^{M} e^{-j\theta_i} z_i(t) \quad (3)$$

with : M = total of path

With diversity combing technique, it will result an output information signal that undergone the improvement of the performance. The signal of the resulting output of diversity combing block will undergone the demodulation QPSK to become the input of decoder Reed-Solomon. The bit stream of demodulation QPSK output will be regrouped to symbols and then put to decoder Reed-Solomon to correct the error data as well as eliminate parity from the received data.

Two parameters which use to measure the quality of system are BER (Bit Error Rate) and PSNR (*Peak Signal to Noise Ratio*). The measure of BER is done by comparing the resulted output. By measuring BER (Bit Error Rate), the influence of diversity equal gain combining technique on this system can be shown. By looking at the difference of BER value between system that use diversity equal gain combining and the system without using diversity equal gain combining, we can see the influence of diversity EGC (Equal Gain Combining) techniques on the. The smaller of BER mean the better of the system. The second parameter to measure the quality of the system is by measuring PSNR (Peak Signal to Noise Ratio). It is done by comparing between input image and resulted medical image (medical image reconstructed)

3. EXPERIMENTAL RESULTS

The Simulation of the performance of medical image transmission with Diversity Equal Gain Combining technique and it based. The analysis based on the result of symulation. The following table is the comparison of the value of SNR, BER, and PSNR of medical image.

Tabel-1 The comparison of value between BER and PSNR of medical image transmission with Diversity EGC technique and without Diversity EGC technique.

SNR (dB)	Without Diversity Equal Gain Combining	
	BER	PSNR (dB)
10	0,0551	9,6276
12	0,0123	11,3681
14	0,0074	16,0076
16	0,0073	19,2432
18	0,0003	23,1749
20	$2{,}5266 \times 10^{-4}$	26,5359

SNR (dB)	With Diversity Equal Gain Combining	
	BER	PSNR (dB)
10	0,0103	12,6276
12	0,0014	18,3681
14	0,00001	25,0076
16	$3{,}5342 \times 10^{-5}$	27,2432
18	$1{,}2622 \times 10^{-6}$	29,1749
20	0	32,5359

From the above table, it can be seen that on SNR 10 dB on system with diversity Equal Gain Combining will get the value of BER 0,0103 and the value of PSNR 12,6276 dB, while system without diversity Equal Gain Combining will get the value of BER 0,0551 and the value of PSNR 9,6276 dB. From the result, it can be seen that the improvement of the system with diversity Equal Gain Combining if compare to system without diversity Equal Gain Combining. For the value of PSNR, there is an improvement 6,1523 dB and for the value of BER there is a decrease 0.0583. The improvement of PSNR value happened on every SNR value from 10 dB to 20 dB for the system without diversity Equal Gain Combining, while for system with diversity Equal Gain Combining, the improvement of PSNR value done from SNR 10 dB to 20 dB. The decrease of BER value happened on every SNR value to the value of BER zero, it happened to SNR 20 dB for system with diversity Equal Gain Combining.

For medical image on increase of PSNR average value is 7.8346 dB for the value of SNR from 10 dB to 20 dB. For the value BER will result the decrease of average 0.0514.

4. CONCLUSIONS

Base on the experimental, it can be concluded that the increase of SNR value resulted on the decrease BER, but it does not always increase the value of PSNR of medical image reconstruction. It resulted that the value of PSNR does not depend on the total of bit error, but it depends on the placement of bit error on bit circuit. The increase of bit per pixel does not impact on BER value but it impact to the PSNR value of medical image reconstruction. The bigger of bit per pixel, means the bigger of PSNR value. On Barbara image 0.7 bpp there is the

increase of PSNR on the average of 6.9296 dB and the decrease of BER on the average of 0.0214

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