

Performance Evaluation of CDMA - MIMO (STBC) System over Rayleigh Fading Channel for Image Transmission

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Abstract Data transmission via wireless communication system is not only in text form but it also can be in image form. In the process of sending data or information, it often experiences interference in transmission media, which is fading. The method used in this research is by simulation using MATLAB. The simulation of CDMA-MIMO (STBC) system with Walsh spreading code is expected to reduce the disturbance of fading. Fading channels can be modeled using Rayleigh distribution. The number of users and spreading factors affect the performance of CDMA-MIMO (STBC) systems. The parameters used in this simulation were SNR, BER, and PSNR. The results showed that image reconstruction passing CDMAMIMO system with spreading factor 4 has better image quality. Its PSNR 33.9589dB when SNR -10dB. SNR was increased 10 dB then PSNR 60.00 dB. The increasing of spreading factor to 8 and 16 was obtained by increasing PSNR, PSNR 35.0685 dB and PSNR 37.5665 dB, respectively. For 4 users with Spreading Factor 4 and SNR 0 to 5 dB, it was changed the BER. This is influenced by changes in SNR. The higher SNR value, the average value of BER will be smaller. A growing number of users from 1 to 4 users were decreased the performance of the MIMO CDMA system when observed from the BER and PSNR.

Index Terms— CDMA, MIMO, Rayleigh Fading, Image, Spreading Factor.

I. INTRODUCTION

Mobile radio technology has always evolved from analog technology used in the first generation (1G) and then developed to digital technology in the fourth generation (4G). One telecommunication technology is being implemented, CDMA. Code division Multiple Access (CDMA) is a form of multiplexing and a shared access method that divides the channel by encoding data with a special code and using the constructive interference properties of the special codes to perform multiplexing.

The radio wave propagation between the transmitter and the receiver will pass through different paths. With the different paths resulting in reflection (reflection), scattering, and diffraction on the signal is often referred to as fading. Rayleigh distribution is used to explain the shape of signal envelope on fading channel. One of which reducing the fading effect on the communication channel in telecommunication services is done by diversity technique or often called diversity. This diversity is known as MIMO (Multiple-Input Multiple-Output) system. In transmitter

diversity requires a combination of space and time diversity through a technique called Alamouti space-time block codes (STBC) scheme. This system uses more than one transmit and receive antennas. It aims to make the reflected signal as the main signal amplifier so that mutual support or not eliminate each other

The purpose of this research is to know the effect of transmission Jpeg compressed digital image data on CDMA-MIMO system using Walsh spreading code on Rayleigh distributed fading channel with different spreading factor and number of users more than 1 user. The CDMA-MIMO system performance is seen from the relationship between the BER (bit-error-rate) and SNR (signal-to-noise-ratio) and PSNR (Peak Signal to Noise Ratio).

II. RESEARCH METHODS

In the performance of analyze of CDMA MIMO with the number of user from 1 to 4 user and Spreading Factor changed there are some things to be considered, so that the simulation can be done. Beginning with the literature understanding from various sources about system modeling. The design stage of the simulation program is based on the

issues to be discussed, such as input data using JPG compressed digital image, system modulation, fading channel and CDMA MIMO system. MIMO used is MIMO STBC (Space Time Block Code) with maximum detection like hood. The system simulation with Matlab software version R2013a. A completed simulation program needs to be evaluated to avoid any deficiencies or errors. System performance reference used BER value (Bit Error Rate) and PSNR (Peak Signal to Noise Ratio). The performance parameters of CDMA MIMO system from simulation can be shown in table 1.

TABLE I
SIMULATION PARAMETER OF CDMA MIMO SYSTEM MODEL

Parameter	Item
User	4
Image compressed	Jpg
Image Resolution	128 x 128
Spreading Factor	4,8, 16
Modulation	QPSK
Spreading Code	Walsh
Channel	Rayleigh Fading and AWGN

Configuration of simulation block diagram of CDMA MIMO system performance with change of number of users (1 to 4 user) and Spreading Factor = 4 can be seen in figure 1.

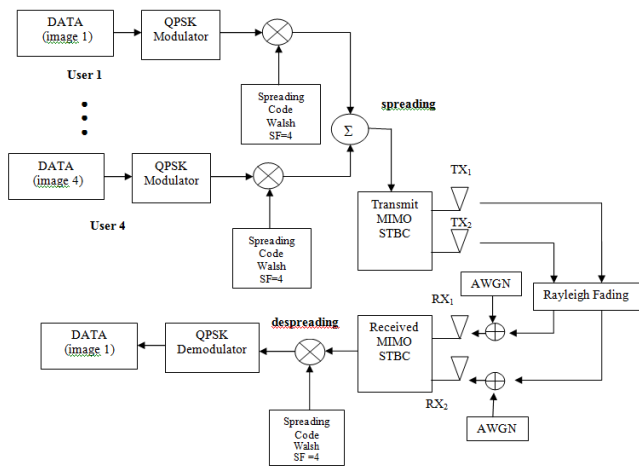


Fig. 1. Block diagram of CDMA MIMO system performance with 4 user and number Spreading Factor = 4

III. SIMULATION RESULTS AND DISCUSSION

This section will describe the performance of CDMA MIMO (STBC) in transmitting data in jpg compressed image for Walsh spreading code over Rayleigh distributed fading channel seen from the value of BER and PSNR generated.

A. CDMA MIMO Simulation with different Spreading Factor

The result of simulation of CDMA MIMO system performance with 1 user number for Walsh Spreading code which vary Spreading Factor are 4, 8, and 16 on channel fading distributed Rayleigh with SNR starting from -10 dB, 5 dB, until a maximum of 10 dB is performed up to 5 experiments to obtain the average BER shown in graphical form in figure 5.9. The system input is a digital image of cameraman.jpg with 128x128 resolution that has been changed into bit form by using Matlab. Output from jpg compressed image with 128 x 128 resolution on CDMA MIMO system with 1 user for SNR of -10 dB and - 5dB with PSNR as reference of system performance shown in figure 2.

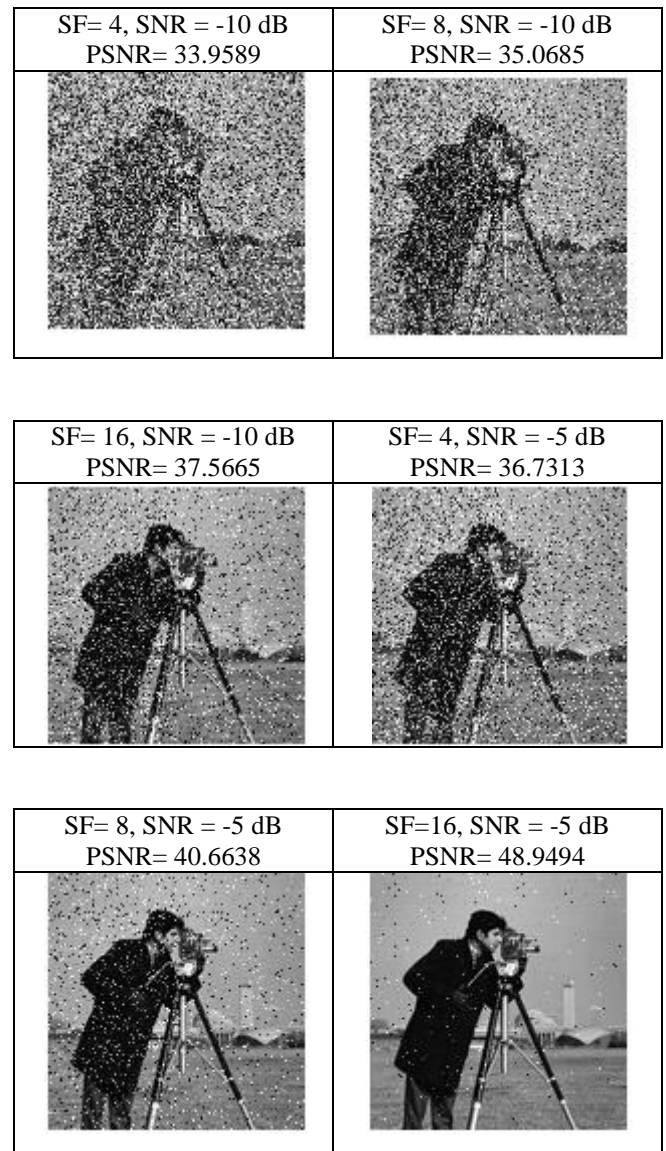


Fig.2. Output of the CDMA MIMO system for cameraman image with SNR = -10 dB and -5 dB

Based on PSNR value for CDMA MIMO system with SNR of -10 dB is 33.9589 dB, with SNR addition being -5 dB PSNR value of 36.7313dB. This shows that the result of image reconstruction passing through CDMA-MIMO system with SNR value addition has better quality. Performance improvements also occur in CDMA-MIMO systems using Spreading Factor = 8 and 16.

B. CDMA MIMO Simulation with different User

The performance simulation of CDMA MIMO system with jpg compressed image input for 4 users for Walsh and Spreading Factor = 4 on Rayleigh distributed fading channel with SNR of 0 dB and 5 dB can be seen in Figure 3.







User 1 Cameraman.jpg	User 2 Zelda.jpg
	
User 3 Boat.jpg	User 4 Goldhill.jpg
	

Fig 3. Compressed digital image with 128x128 resolution as CDMA MIMO system input for 4 user.

The output of the compressed image on the CDMA - MMO system with the addition of the user for SNR of 0 dB and 5dB is shown in figure 4 and figure 5.

1 user SNR = 0 dB BER =0.01297 PSNR =45.6433	2 user SNR = 0 dB BER =0.06022 PSNR =39.0189
	



3 user SNR =0 dB BER =0.10878 PSNR =36.8833	4 user SNR =0 dB BER =0.14710 PSNR =35.6705
	

Fig 4. Output from CDMA MIMO system with different user for spreading factor = 4 on SNR = 0 dB





1 user SNR = 5 dB BER =0.0001754 PSNR =60.0000	2 user SNR = 5 dB BER =0.00303 PSNR =51.5244
	
3 user SNR = 5 dB BER = 0.01182 PSNR =45.6887	4 user SNR = 5 dB BER = 0.0240 PSNR =42.5134
	

Fig 5. Output from CDMA MIMO system with different user for spreading factor = 4 on SNR = 5 dB

PSNR value for CDMA MIMO system with SNR of 0 dB for 1 user is 45.6433 dB. With the addition of the user to 4, the PSNR value is 35.6705 dB, then the maximum regulated SNR of 5 dB has a PSNR value of 60 dB if the number of users 1, and the PSNR value decreases by 42.5134 dB for the addition of the user number of 4 users. This shows that the image reconnaissance that passes of the CDMA MIMO system with spreading factor 4, has a better quality when 1 user sends the image. The performance decline also occurs in the MIMO CDMA system which 4 users as shown in Figure 4.

IV. CONCLUSION

From the results of the analysis that has been done on the performance of CDMA MIMO system over Rayleigh fading channel for data transmission in the form of compressed image, it can be drawn some conclusions as follows,

- 1) Result of image reconstruction passing CDMA MIMO system with 2 transmitters and 2 receiver antennas have better image quality with PSNR of 33.9589dB when SNR -10dB, and SNR increased to maximum 10 dB will have PSNR 60.00 dB for spreading factor 4. The increasing of spreading factor to 8 and 16 was increased PSNR, PSNR 35.0685 dB and PSNR 37.5665 dB, respectively, SNR is -10 dB.
- 2) Performance of CDMA MIMO system with 4 users for Spreading Factor = 4 and SNR = 5 dB was experienced BER 0.0240 and PSNR 42.5134. The increasing number of users from 1 to 4 users was decreased system performance based on BER and PSNR parameters.

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