UNEQUAL POWER ALLOCATION FOR IMAGE TRANSMISSION WITH CHAOTIC COMMUNICATION

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ABSTRACT: The encroachment of wireless communication within the last few decades has resulted in the development of multiple transmit and receive (MIMO) systems enabling efficient real-time image and video communication. These advantages of multiple antenna systems alongside efficient transmission and coding schemes may be explored to attain quite high data rates alongside improved data reliability. Following the concept this paper presents a novel approach for transmitting images over a noisy channel. The proposed method employs OFDM and chaotic encoder schemes to attain distortion less and secure image transmission within the noisy channel.

KEYWORDS: MIMO system, OFDM, chaos, unequal powerallocation, distortion.

INTRODUCTION

The tremendous boom in the electronics and wireless communication industry has led to on-the-move internet facility and cheaply available wireless devices. Further use of images and videos has increased the data transfer by many folds. This has set the need of efficient and reliable communication techniques with data rates. To cater to these needs recent advances in the field of wireless communications has led to some remarkable breakthroughs in the region of multiuser space-time wireless communications.

The discovery of the multiple-input multiple-output (MIMO) wireless systems shows tremendous potential to relieve the bottleneck of wireless data transmission. MIMO offers a growth in traffic capacity for future cellular systems, to handle the task of internet-intensive applications. MIMO communication system uses multiple antennas at the transmitter and the receiver that creates virtual spatial subchannels, over which multiple data streams can be transmitted. Each subchannel uses the exact same frequency, and the transmissions occur simultaneously. In fact MIMO systems can be considered as an extension of smart antenna systems, a favorite technique, dating back several decades, for improving link reliability through the use of antenna array beam forming [1]. Further even the future 4G wireless networks will combine the powerful technologies of MIMO, adaptive and reconfigurable systems (software radio) and wireless access technologies such as for example orthogonal frequency division multiple access (OFDMA) and multiple-carrier code division multiple access (MC-CDMA) [2].

This paper presents a story idea of unequal power allocation scheme for transmission of digital images over a MIMO system. The proposed system employs the usage of OFDM and chaotic communication to transmit the input images from different transmit antennas using unequal transmit power of the MIMO system.

LITERATURE SURVEY

Since 1990s, an ever-increasing interest has been the usage of chaotic functions to implement the encryption process. Chaotic communication is an application of chaos theory to provide secure transmission of data [3]. A chaotic system thus can be termed as a deterministic system exhibiting non-linear systems behavior with certain eminent features. Such a system employs the use of complex dynamic behavior such as pseudorandom noise and spread spectrum to encode data. Synchronization of chaotic systems and its secure communication applications have been a major research area over the last decade [4, 5]. Pecora and Carroll, in their ground-breaking work [6] have proposed a stable chaotic sub-system for constructing unidirectionally coupled synchronized systems.

Chaotic communication methods such as chaotic masking, chaotic shift keying [7] and those on the basis of the projective synchronization [8] and phase synchronization [9] have also been analyzed and proposed to be secure. In [10] a secure digital communication system based on chaotic modulation, cryptography, and chaotic synchronization techniques have been proposed and analyzed numerically. In [11], a way based on encryption technique is proposed. The proposed system uses different output from chaotic transmitter, transmitted in the channel as a keystream to encrypt the message signal.

CHAOTIC ENCODER FORMULATION

A general chaotic system can be described by following equation:

$$x' = Ax + g(x) \qquad (1)$$

where Au is the linear part, $g(x)$ is the nonlinear part of the system. For this paper we construct chaotic system by using Lorenz's chaotic system which is an autonomous 3-order nonlinear system [12] and can be represented in following states:

$$x'_1 = A (x_2 - x_1) \qquad (2)$$

$$x'_2 = c x_1 - x_1 x_3 - x_2 \qquad (3)$$

$$x'_3 = x_1 x_2 - bx_3 \qquad (4)$$

where a, b, and c are constants greater than zero and x_1, x_2, and x_3 are the dynamic states. The input message M is masked by the Encrpt and decrpt systems are presented as following:

Encrypt side(master): $x' = Ax + g(x, v) + Lz_x$ (5)
Where $v = u_1 + M$

Decrypt side (slave): $y' = Ay + g(y, v) + Lzy$ (6)

chaotic state and transmitted. The equations of where $x \in R^n$, $y \in R^n$ are the state vectors. Ax and Ay are the linear part, $g(x,v)$ and $g(y,v)$ are the nonlinear part of this system, L is the controller gain of the system, K>0 is the coupling strength between master and slave system, z_x and z_y are the feedback signal.

PROPOSED SYSTEM

The Proposed system employs the combination of OFDM (Orthogonal Frequency Multiple Access) and Chaotic Communication. Fig. 1 below shows block diagram of the transmission section of the proposed system. The input image is first converted into bits and then these bits are given to different chaotic encoder blocks. The output of the encoders is then given to the OFDM respective transmitters section. The OFDM outputs are then transmitted using the different antennas of the MIMO system as shown in Fig. 1. At the receiver side, the receiving antennas receiver the transmitted image copies. The received bits are first given to the OFDM receiver, the output of which is given to the chaotic decoder. The mean of the outputs from the chaotic decoders is calculated the finally converted to give the final output image as in Fig. 2. Since the proposed technique uses employs a MIMO system the transmitted copies of images at different input power levels undergo different distortion through the channel. At the receiver these image copies are decoded and a mean is calculated to give the output image. This minimizes the distortion in the received image.
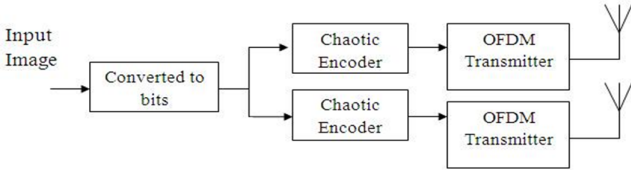
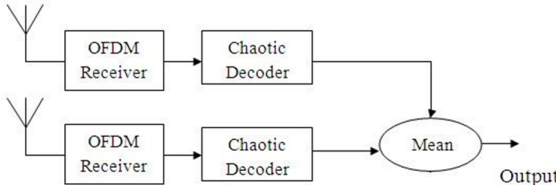Fig 1: Transmitter Sec. of proposed System

Fig 2: Receiver Section of proposed system

RESULTS

The proposed model has been implemented in MATLAB. Fig 3 below shows the input image and Figure 4 shows the output of the OFDM transmitter blocks. Fig 5 shows the BER v/s SNR graph for the proposed system. From the graph it is clear that the BER for the transmission of image in Fig 3 is of the order of 10^{-6}. Fig 6 shows the delay (in ms) graph for various SNR values. Fig 7 shows the processed input and the decoded output images. Since the BER for the image is very less the output image is exact replica of the input image. The proposed system is tested using different images and it is fund that the proposed system has very less BER as compared to simple

transmission of the image through the same channel.

Table 1 below shows the comparison of BER for transmission few standard images in Microsoft windows using the proposed method using a MIMO system and through a simple single OFDM transmitter for an SNR of 30dB. From the table its is seen that the proposed method has a better BER for the SNR value as compared to simple transmission of an image through single OFDM transmitter.

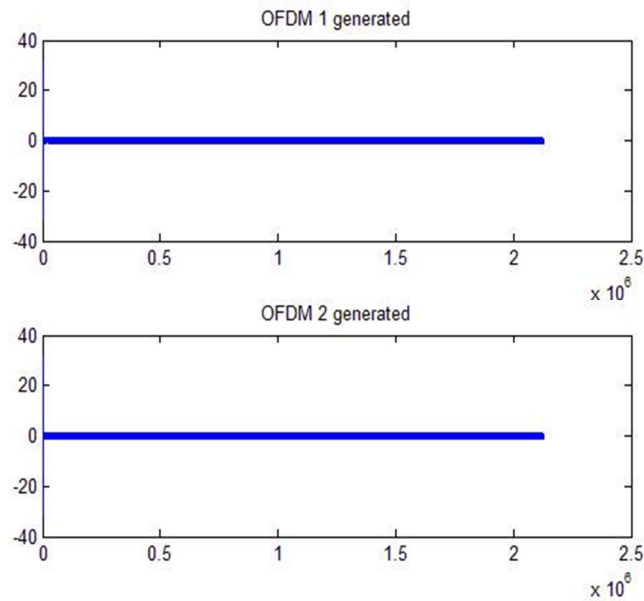Figure 3: Receiver Section of proposed system
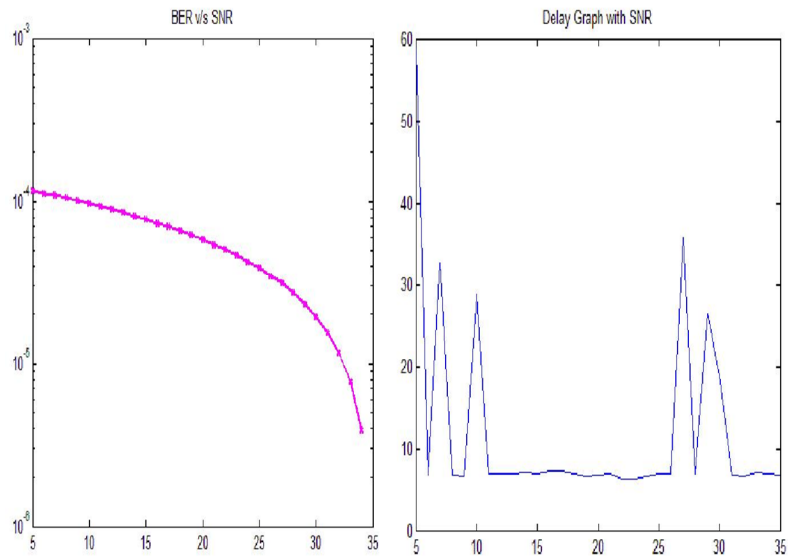

Figure 4: OFDM   Transmitter output Proposed systm

Figure 5: BER v/s SNR graph of proposed system

Figure 6: Processed Input and Output Images

Table 1: Comparison table for BER at 30dB SNR

Image Input	BER for proposed MIMO system	BER for single OFDM transmitter
Penguin	1.2×10^{-4}	2.2×10^{-3}
Desert	1.7×10^{-4}	3.9×10^{-3}
Flower	1.5×10^{-4}	3.5×10^{-3}
Jelly fish	1.1×10^{-4}	3.1×10^{-3}
Light house	1.2×10^{-4}	1.7×10^{-3}
Koala	1.4×10^{-4}	2.6×10^{-3}
Water lilies	1.6×10^{-4}	2.9×10^{-3}
Sunset	1.8×10^{-4}	2.5×10^{-3}

CONCLUSION

In this paper, we presented an unequal power allocation scheme for the transmission of compressed images over MIMO systems over a noisy channel. The proposed system employs OFDM and chaotic encoder schemes. The input is passed through chaotic encoder and OFDM transmitter and is transmitted using MIMO configuration. At the receiving end reverse is followed and then the mean of the received image is calculated to give the output image. The chaotic encoder ensures secure image transmission and the use of two separate transmitters reduces the channel distortion. The proposed system is tested using various images. The results show that the proposed system has less delay and less BER for a given SNR.

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