ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

IJESRT

INTERNATIONAL JOURNAL OF ENGINEERING SCIENCES & RESEARCH TECHNOLOGY

PERFORMANCE ENHANCEMENT USING FUZZY DE-NOISING FOR IMAGE TRANSMISSION OVER MIMO WIMAX FOR QAM-8 MODULATION

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ABSTRACT

The image transmission over wireless channel is already explored by many researchers. Due to eye perception for only low frequency component the de-noising technique may be add at receiver end of the wireless device. In this paper WiMAX system are used for image transmission and fuzzy de-noising method is used for improving the performance. PSNR and RMSE are taken as two parameters for comparing the performance. The MIMO technique is also used here with the 2 x 1 antenna system for BER performance improvement. A clear improvement using de-noising technique is found and described in this paper.

KEYWORDS: Fuzzy, MIMO, STBC, WiMAX etc.

INTRODUCTION

The image transmission from one place to another place is most common since many decades. As requirement of communication goes up, the problem of channel behavior for data takes a major limiting role during communication. Today many wireless techniques such as WLAN (wireless local area network), WPAN, and WiMAX etc. are in use for data communication. Due to wireless transmission channel fading and white Gaussian noise become important consideration in the transmission.

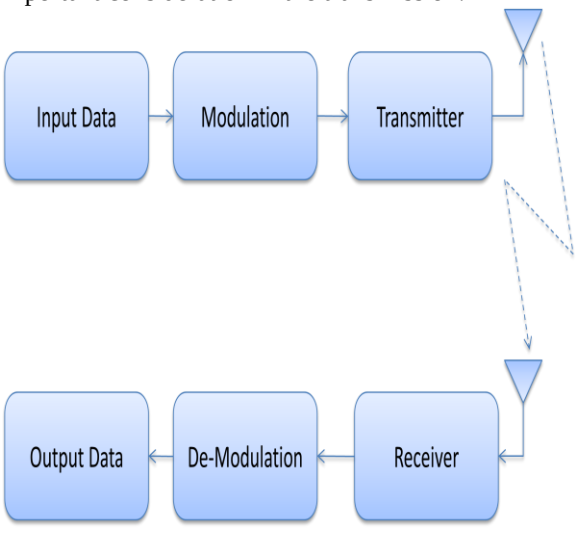

Fig: 1 Communication process

WiMAX stands for worldwide interoperability for microwave access is IEEE802.16 standard based technology which is basically responsible for bringing the broadband wireless access to the world as an alternative to wired broadband techniques. It is capable of providing broadband wireless access up to 50km for fixed station and 5-15km for mobile station with data throughput up to 70mbps.

The WiMAX network is similar to that of a cell phone. as soon as the data is send by a user from a subscriber device to a base station then that base station will further broadcast the wireless signal into channel which is termed as uplink vice versa when the base station transmit to the same or another user is called downlink process. Here the base station of WiMAX is provided with higher broadcasting power antennas system. The broadband service of WiMAX technology is available in coverage area. The wireless connection is transferred from one cell to another when a user sends data from one location to another. The architecture of WiMAX is based on connection oriented that is MAC layer. Design WiMAX system is to facilitate large number of user with a variety of connection per terminal process. The important feature of WiMAX includes interoperability, handoff, long range, quality of service etc. The present paper discusses the model building of WiMAX MIMO physical layer using simulink in matlab and models proves to be a useful

tool for the performance evaluation of the WiMAX MIMO system under various efficient wireless channels using the real time data.

Fuzzy image processing is the collection of all approaches that understand, for represent and process the images, their segments and features as fuzzy. The representation and processing depend on the selected fuzzy technique and on the problem to be solved. For instance, we want to define a set of gray levels that share the property dark. In classical set supposition, say the gray level 100. All gray levels between 0 and 100 are element of this set: the others do not belong to the set. So, a fuzzy set can model this property much better. This observation underpins many of the other statements about fuzzy logic. The basis for fuzzy logic is the basis for human communication. Because fuzzy logic is built on the structures of qualitative description used in everyday language, the fuzzy logic is easy to use. A filtering system needs to be capable of reasoning with vague and uncertain information this suggests the use of fuzzy.

MULTIPLE INPUT MULTIPLE OUTPUT (MIMO) SYSTEM

MIMO systems transmits different signals from each transmit element so that the receiving antenna array receives a superposition of all the transmitted data. All signals are transmitted from all elements once and the receiver solves a linear equation system to demodulate the message. Multiplexing (MIMO-OFDM) system is an effective solution to improve communication quality, performance, capacity, and transmission rate.

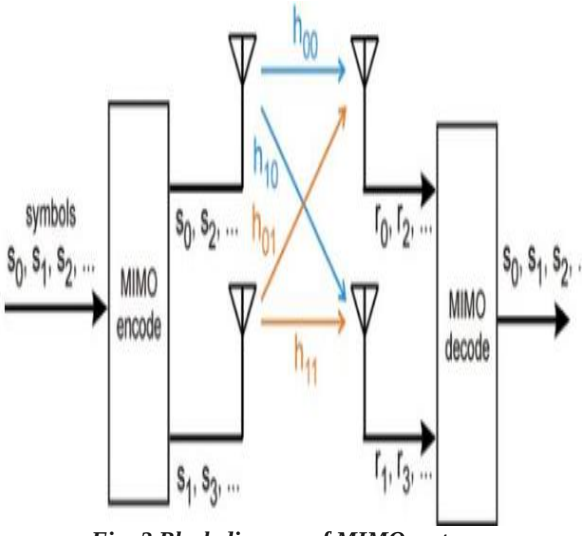

Fig: 2 Block diagram of MIMO system

Main tool for increasing the transmission rate with multiple transmit antennas system consist of transmitting more independent stream, layers of data from all available transmit antennas, simultaneously. For more specific terms, if we have a system with N transmit antennas, we can transmit simultaneously, Nt independent symbols one from each t transmit antenna. At the receiver, we can get, at any time instant Nr observations one from each receive antenna. Therefore at any time instant, they have a system of Nr observations in Nt unknowns.

Time diversity: A message may be transmitted at different times. using different timeslots and channel coding.

Frequency diversity: This form of diversity uses different frequencies communication. It may be in the form of using different channel or technologies such as spread spectrum / OFDM.

Space diversity: Space diversity used in the broadest sense of the definition is used as the basis for MIMO system. It uses antennas located in different positions to take advantage of the different radio paths that exist in a typical terrestrial environment.

FUZZY BASED IMAGE DENOISING TECHNIQUES

The fundamental problem of image and signal processing is to effectively reduce noise from a digital image while keeping its features intact. The nature of the noise removal problem depends on the type of the noise corrupting the image.

Noise in an image

The two types of noise are
(i) Additive noise
(ii) Multiplicative noise

Impulse noise is usually characterized by some portion of image pixels that are degraded, leaving the remaining pixels unmovable. Examples of impulse noise are fixed-valued impulse noise and randomly valued impulse noise system. Multiplicative noise is generally more difficult to remove from images than additive noise because the intensity of the noise varies with the signal intensity. In tile literature several (fuzzy and non-fuzzy filters have been studied for impulse noise reduction. In the impulse noise is caused by errors in the data transmission generated in noisy sensors or communication network, or by errors during tile data capture from digital cameras. Corrupted pixels are either set to the maximum value or have single bits flipped over. Single pixels are set alternatively to zero or to the maximum value. Noise smoothing and edge enhancement are inherently conflicting processes,

ISSN: 2277-9655
(I2OR), Publication Impact Factor: 3.785

smoothing a region might destroy an edge, while sharpening edges might lead to unnecessary noise.

FUZZY FILTERS

Noise reduction is an important area for image processing. Besides classical filters, there are lots of fuzzy filters in the literature. Images can be corrupted with impulse noise, Gaussian noise or both. Depending on the type of noise, filters can be used. The fuzzy filters are categorized into two subclasses:

a. ***Fuzzy-classical filters:*** Fuzzy Classical filters are filters that use fuzzy logic and these are the modification of the classical filter.

- Fuzzy median filter- Fuzzy median filter is well known for removing impulse noise process. It is the fuzzy rank ordering of samples and is simply a replacement of conventional median filter with fuzzy counterparts.
- Fuzzy impulse noise detection and reduction method- this filter by Selhulte detects the impulse noise and any other noise in the image. It contains the noise detection step and filtering step to preserve the edges. The fuzzy detection step uses fuzzy gradient values in eight directions with a 3 x 3 window system, which indicates the degree of central pixel as an impulse noise pixel.

b. ***Fuzzy filters:*** These are filters that are totally dependent on fuzzy logic and they do not have any connection with classical filters. A few fuzzy filters ale discussed below.

- Gaussian noise reduction filter (GOA) - This filter is specially designed to remove Gaussian noise method. Averaging is done for a pixel using other neighborhood pixels and simultaneously taking care of the other image structures such as edges. To achieve this, two features are required. First, in order to distinguish between the variations die to noise and the image structures, the filter uses gradient for all the eight directions. In second, the membership functions are adapted accordingly to the noise level to perform fuzzy smoothing. The filter is applied iteratively.
- Histogram adaptive filter (HAF) - This type of filter removes high impulsive noise, preserving edge in sequence. In HAF, each input pixel is considered a fuzzy variable and a square window of size 3X3 is sided over the entire image and the filter output is associated with each centre pixel in a window system. Three fuzzy sets for Medium, dark, and bright are created and the membership functions for these fuzzy sets are considered. Then fuzzy inference rules based on the Takagi-Sugeno approach with a slight difference is used in a final output decision process.

Image de-noising still remains a challenge for researchers because noise removal introduces artifacts and causes blurring of the images. This paper describes different methodologies for noise reduction giving an insight as to which filter should be used to find the most reliable estimate of the original image data analysis of some methods that are available in the literature is given in below section.

QUADRATURE AMPLITUDE MODULATION (QAM)

The QAM is popular modulation technique used in various wireless standards. It combined with ASK and PSK which has two different signals sent concurrently on the same carrier frequency but one should be shifted by 90º with respect to the other signal. The principle equation 4 is.

$$s(t) = d_1(t)\cos 2\pi f_c t + d_2(t)\sin 2\pi f_c t \,. -4)$$

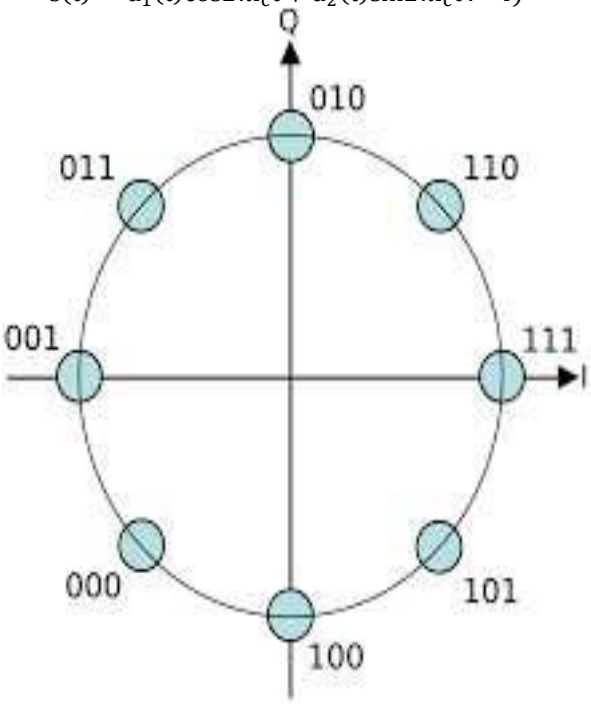

Fig: 3 QAM 8

PSNR

To measure the quality of reconstruction of lossy compression PSNR is frequently used. And it is the ratio of the maximum possible power of a host image to the power of corrupting noise that affects the

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fidelity of its representation. They is define by the following equation:

$$\mathrm{PSNR_{dB}} = 20 \times \log_{10}\left(\frac{\mathrm{MAX}}{\sqrt{\mathrm{MSE}}}\right) \quad (2)$$

MSE is measured from the host image and noisy approximation of it. In the MSE can be defined by the equation (4)

$$\mathrm{MSE} = \left(\frac{1}{m \times n}\right) \sum_{k-1}^{m} \sum_{l-1}^{n} (f(k,l) - f'(k,l))^2 \quad (3)$$

Where, $f(k,l)$ is host image and $f'(k,l)$, is watermarked/embedded image.

RESULTS AND DISCUSSION

The system block diagram is shown in figure 5. The system contin the basic MIMO-WiMAX communication with the Fuzzy denoising block. The BER performance graphs for the simulated WiMAX physical layer and MIMO with the implementation of FEC coding under 8 QAM digital modulation schemes over AWGN channel.

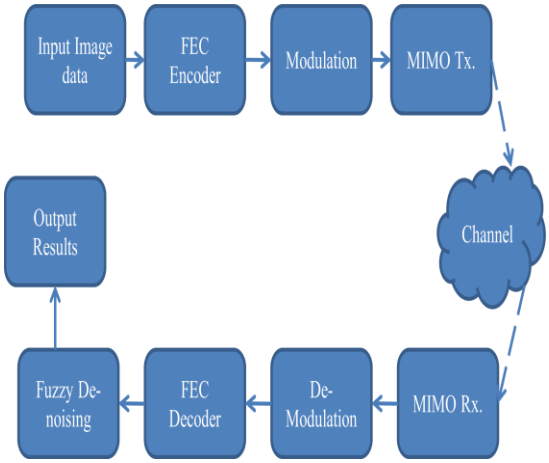

Fig: 4 Simulation system block diagram

Parameter

SNR8
PSNR

Fig: 5 Transmit image for MIMO 2X1 with WiMAX

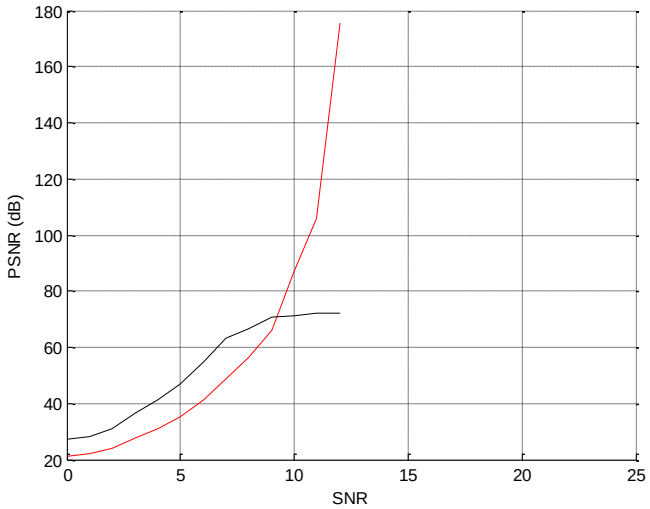

Fig 6.The Performance of PSNR Vs SNR

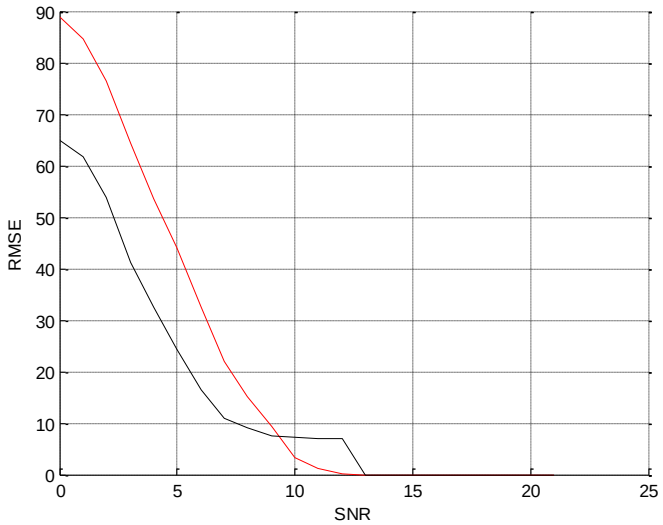

Fig 7.The Performance of RMSE Vs SNR

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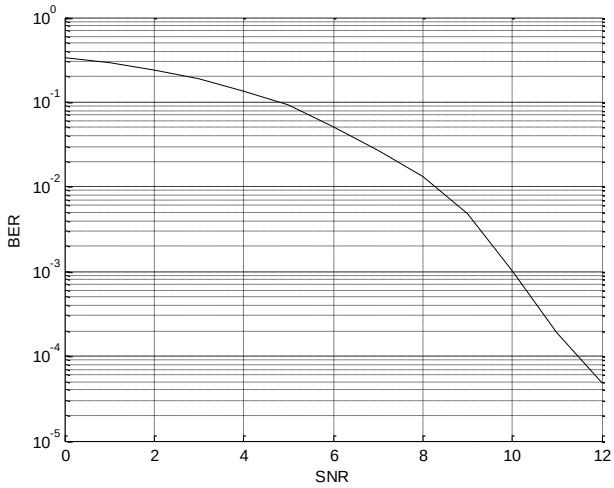

Fig: 8 The Performance of BER Vs SNR

CONCLUSION

The simulation results shows that the use of MIMO-WiMAX system gives better performance for image transmission. The MIMO technique is also used here with the 2 x 1 antenna system for BER performance improvement. In this paper WiMAX system are used for image transmission and fuzzy de-noising method is used for improving. PSNR and RMSE are taken as two parameters for comparing the performance.

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