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Performance Evaluation of 256 PSK Modulation over Various Channels for MIMO –OFDM Wireless System using Receive Beamforming

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Abstract: *The smart antennas are widely used for wireless communication, because it has a ability to increase the coverage and capacity of a communication system. Smart antenna performs two main functions such as direction of arrival estimation (DOA) and beam forming. Using beam forming algorithm smart antenna is able to form main beam towards desired user and null in the direction of interfering signals. In this project Direction of arrival (DOA) is estimated by using MUSIC algorithm. Receive Beam forming is performed by using LMS and LLMS algorithm .In this Paper, in order to perform secure transmission of signal over wireless communication we have used chaotic sequences. This paper evaluates the performance 256PSK over Different channels for MIMO-OFDM wireless system using beam forming with and without LMS and LLMS algorithm. The simulations are carried out using MATLAB.*

Keywords: OFDM, MIMO, MUSIC, LMS, LLMS, 256PSK, Beamforming

I. INTRODUCTION

Orthogonal frequency division multiplexing (OFDM) is a multicarrier modulation scheme that combines a large number of low data rate carriers into a composite high data communication system. Unlike in many other modulation techniques, the addition of cyclic prefix to the OFDM symbols combats the intersymbol interference and the orthogonality of the carriers allows it to combat Intercarrier interference in the OFDM modulation technique. Acknowledging these advantages, OFDM is the most preferred modulation technique in most of the next-generation wireless communication networks for transmitting many forms of digital data with higher efficiency. This paper aims at evaluating the performance of 256 phase shift keying (PSK) techniques over various channels.

To minimize the interference from different directions, smart antennas can be used at the receivers which form the beam in the direction of the incoming multipath and reject the interference coming from other directions.

In a wireless communication scenario, transmitted signals often propagate via just a few distinct paths, for example via a line-of-sight path between transmitter and receiver and/or via paths that are associated with significant reflectors and diffractors in the environment (such as large buildings or mountains). If the directions of these dominant propagation paths are known at the receiver side, beamforming techniques can be applied, in order to adjust the receiver beam pattern such that it has a high directivity towards the dominant angles of reception. By this means, significant SNR gains can be accomplished in comparison to an antenna array with an omni-directional beam pattern. Such SNR gains due to beamforming techniques are often called antenna gains or array gains in the literature. Similarly, if the directions of the dominant propagation paths are known at the transmitter side, the transmit power can be concentrated within the corresponding angular regions and is not wasted for directions that do not contribute to the received signal. Beamforming techniques can also be useful, in order to reduce the delay spread of the physical channel caused by multipath signal propagation. To this end, the transmitter or receiver beam pattern is adjusted such that it exhibits nulls in the directions of dominant distant reflectors. Correspondingly, echoes with excessively large delays are eliminated from the received signal. The basic principle of beamforming is illustrated in Fig1.

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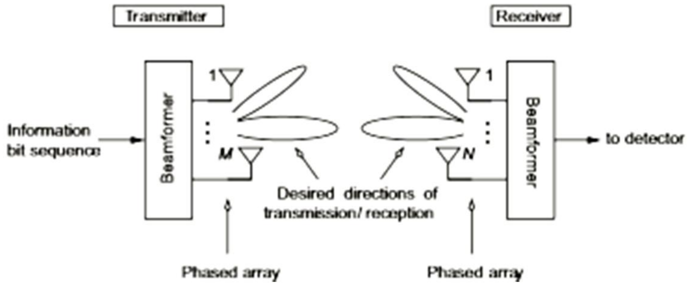

Figure 1: Principle of Beamforming

In the considered example, a beamformer is employed both at the transmitter and at the receiver side. In a practical system, the directions of dominant propagation paths must be estimated. This can, for example, be done by means of the well-known MUSIC algorithm. Moreover, when transmitter or receiver is moving, the antenna patterns must be updated on a regular basis. Such adaptive antenna arrays are often called smart antennas or software antennas in the literature. Due to the required equipment and processing power, however, the use of smart antenna technologies is currently limited to fixed stations, such as base stations, or mobile stations that are fixed on vehicles. Yet, for future wireless communication systems it is anticipated that smart antennas will also be feasible for hand-held devices employing small phased arrays fabricated by microstrip technology.

In beamforming, both the amplitude and phase of each antenna element are controlled. Combined amplitude and phase control can be used to adjust side lobe levels and steer nulls better than can be achieved by phase control alone. The combined relative amplitude a_k and phase shift q_k for each antenna is called a “complex weight” and is represented by a complex constant w_k (for the k^{th} antenna). A beamformer for a radio transmitter applies the complex weight to the transmit signal (shifts the phase and sets the amplitude) for each element of the antenna.

II. Simulation Parameters

By following the above all procedure for simulation, I have taken simulation parameters but by using different channels and different transmitting angle.

Table 1: Parameters taken for simulation

Parameter	**Value/Type**
Input size	1000 bits
No. of Carriers	64
IFFT/FFT size	64
SNR range	1-30
Carrier modulation used	BPSK,QPSK,16PSK,256PSK
Channel used	AWGN, Rayleigh, Rician
Coding Technique	Convolution based Forward error correction with rate 1/3
No of transmitting Antenna	2
No of Receiving Antenna	2
Interfering Angle	10^0
Transmitting Angle	Case 1: TX_1 -10^0 TX_2 - 90^0 Case 2: TX_1 -20^0 TX_2 -180^0

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III. Simulation Results

A. 256 PSK MODULATION OVER RICIAN CHANNEL ($Tx_1=10^0$, $Tx_2= 90^0$)

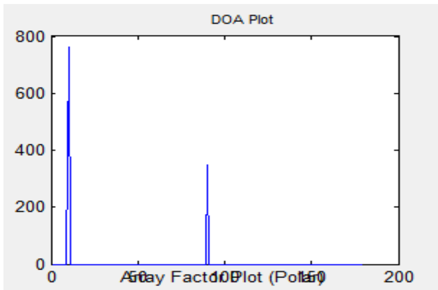

Fig. 1.1 (a) Direction of Arrival Plot

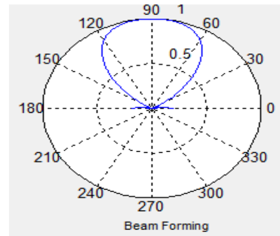

Fig. 1.1 (b) Beamforming

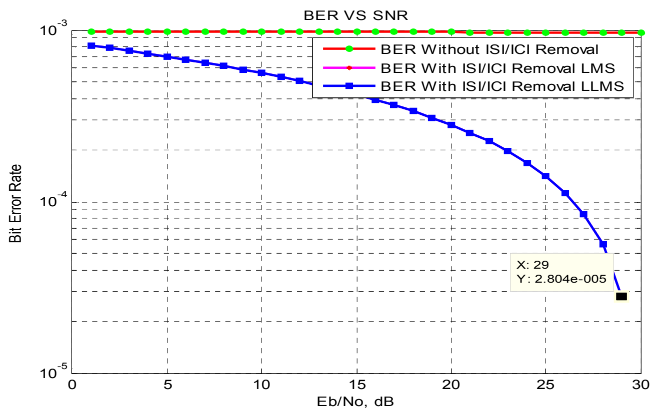

Fig. 1.1(c) Graph between SNR & BER

B. 256 PSK MODULATION OVER RICIAN CHANNEL ($Tx_1=20^0$,$Tx_2= 180^0$)

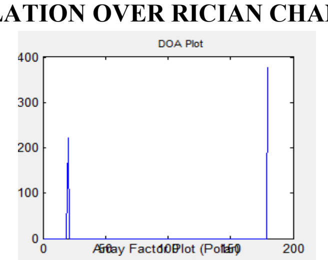

Fig. 1.2(a) Direction of Arrival Plot

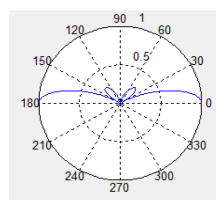

Fig.1.2 (b) Beamforming

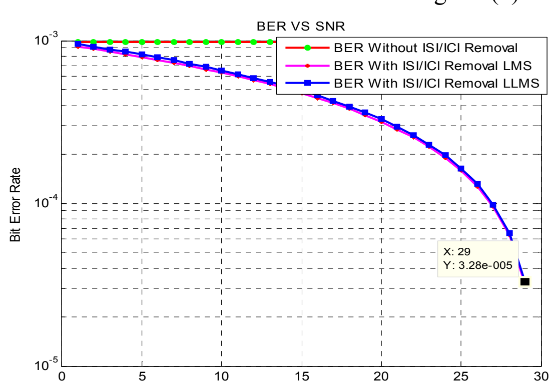

Fig 1.2(c) Graph between SNR & BER

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Table 2: SNR & BER FOR 256PSK (RICIAN channel)

Antenna Angle	RICIAN channel			
	10 ^{0}& 90^0		20^0& 180^0	
SNR	Without Beam forming	With Beam forming	Without Beam forming	With Beam forming
4	0.000982	0.0007291	0.000982	0.0008254
8	0.0009799	0.0006169	0.0009799	0.0007217
12	0.0009778	0.0005048	0.0009728	0.0005905
16	0.0009757	0.0003926	0.0009757	0.0004593
20	0.0009735	0.0002804	0.0009735	0.000328
24	0.0009714	0.0001683	0.0009714	0.0001968
28	0.0009693	0.00005608	0.0009693	0.00006561
29	0.0009688	0.00002804	0.0009688	0.0000328

From the result we have found that BER is less for lower SNR for rician channel using 256 PSK modulation for 10^0 and 90^0 as compared with 20^0 and 180^0 and the width of the beam for the said angle is wider at 90^0 .The slope is gradually decreasing for 20^0 & 180^0 for both algorithm is same as with 10^0 and 90. The slope of BER without beamforming is almost flat.

C. 256 PSK MODULATION OVER RAYLEIGH CHANNEL (Tx_1=10^0,Tx_2=90^0)

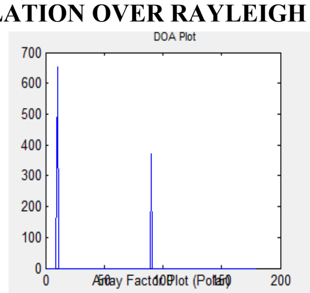

Fig. 2.1(a) Direction of Arrival Plot

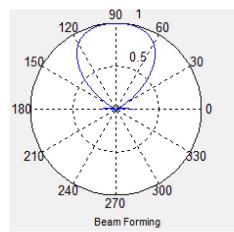

Fig. 2.1(b) Beamforming

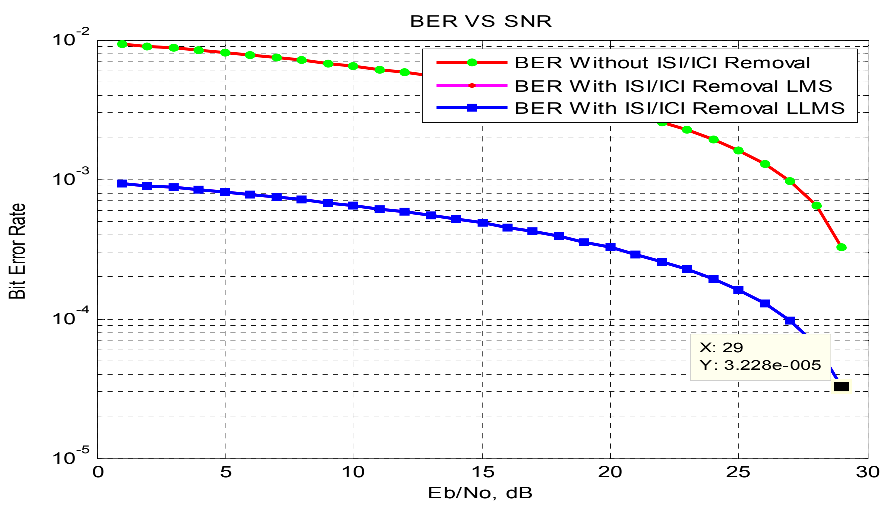

Fig. 2.1(c) Graph between SNR & BER

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D. 256 PSK MODULATION OVER RAYLEIGH CHANNEL ($Tx_1=20^0$& $Tx_2=180^0$)

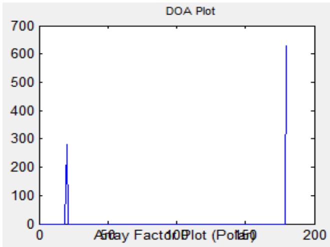

Fig.2.2(a) Direction of Arrival Plot

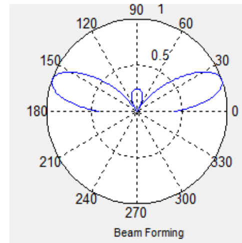

Fig. 2.2 (b) Beamforming

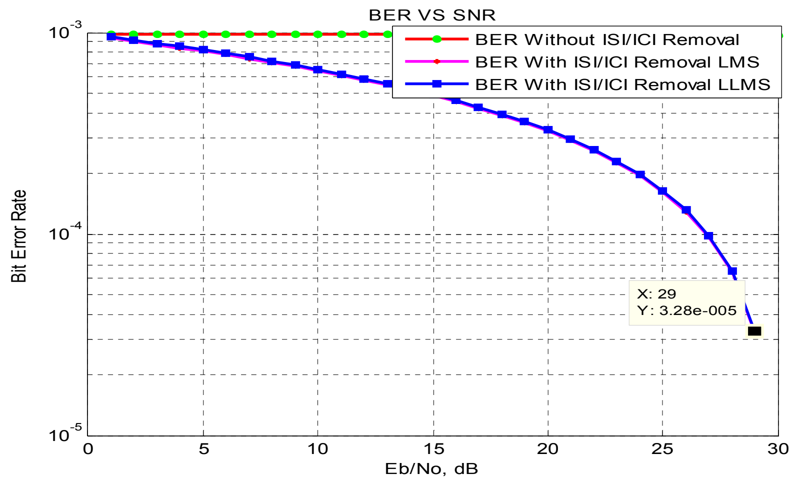

Fig. 2.2(c) Graph between SNR & BER

Table 3: SNR & BER FOR 256 PSK (RAYLEIGH Channel)

	RAYLEIGH Channel			
	10^0 & 90^0		**20^0& 180^0**	
SNR	**Without Beam forming**	**With Beam forming**	**Without Beam forming**	**With Beam forming**
4	0.008392	0.0008392	0.000982	0.0008529
8	0.007101	0.0007101	0.0009799	0.0007217
12	0.00581	0.000581	0.0009778	0.0005905
16	0.004519	0.0004519	0.0009757	0.0004593
20	0.003228	0.0003228	0.0009735	0.000328
24	0.001937	0.0001937	0.0009714	0.0001968
28	0.0006455	0.00006455	0.0009693	0.00006561
29	0.0003228	0.00003228	0.0009688	0.0000328

From the result we have found that BER is less for lower SNR for rayleigh channel using 256 PSK modulation for both 20^0 and 180^0 and 10^0 and 90^0 and the width of the beam for the said angle is wider at 90^0 .The slope is gradually decreasing for 20^0 & 180^0 for both algorithm is same as with 10^0 and 90. The slope of BER without beamforming is almost flat.

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E. 256 PSK MODULATION OVER AWGN CHANNEL ($Tx_1=10^0$, $Tx_2= 90^0$)

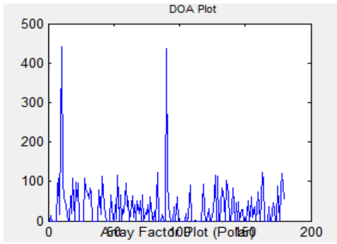

Fig. 3.1(a) Direction of Arrival Plot

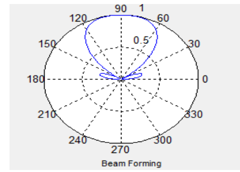

Fig.3.1(b) Beamforming

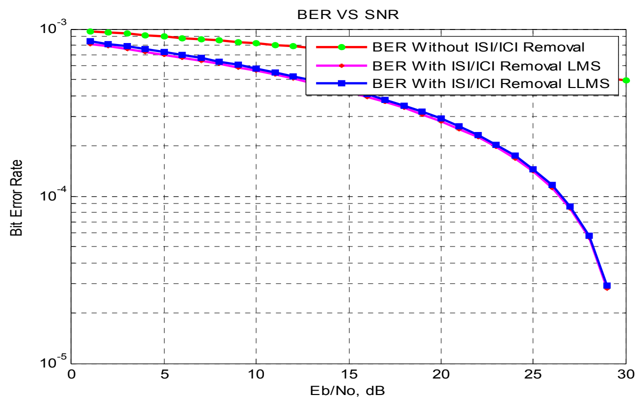

Fig. 3.1(c) Graph between SNR & BER

F. 256 PSK MODULATION OVER AWGN CHANNEL ($Tx_1=20^0$,$Tx_2= 180^0$)

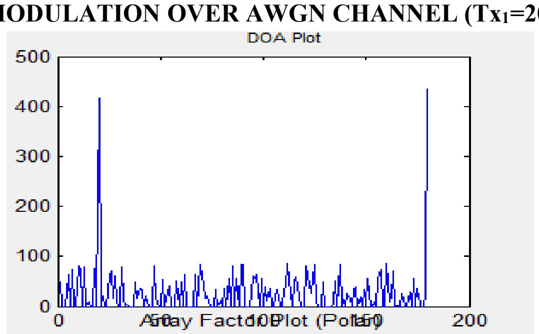

Fig. 3.2 (a) Direction of Arrival Plot

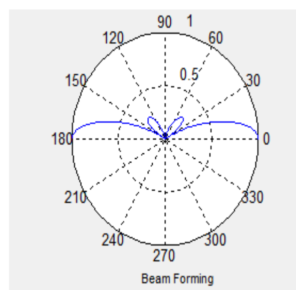

Fig.3.2 (b) Beamforming

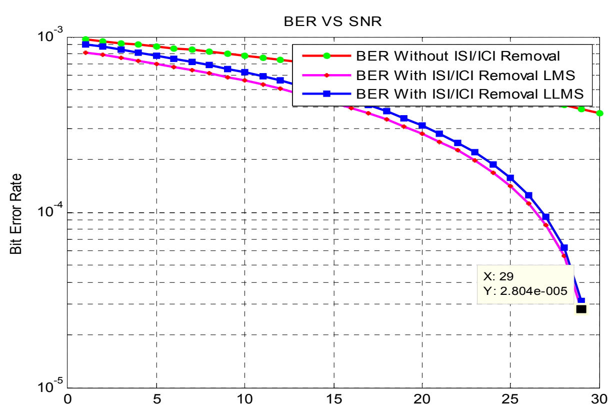

Fig. 3.2 (c) Graph between SNR & BER

Table 4: SNR & BER FOR 256 PSK (AWGN CHANNEL)

	AWGN channel			
	10^0 & 90^0		20^0& 180^0	
SNR	Without Beam forming	With Beam forming	Without Beam forming	With Beam forming
4	0.0009333	0.0007566	0.0009143	0.0007291
8	0.0008825	0.0006402	0.0008444	0.0006169
12	0.0008317	0.0005048	0.0007746	0.0005048
16	0.000781	0.0004074	0.0007048	0.0003926
20	0.0007302	0.000291	0.0006349	0.0002804
24	0.0006794	0.0001746	0.0006349	0.0001683
28	0.0006286	0.0000582	0.0004952	0.00005608
29	0.0006159	0.0000291	0.0004778	0.00002804

From the result we have found that BER is less for lower SNR for AWGN channel using 256 PSK modulation for 20^0 and 180^0 as compared with 10^0 and 90^0 and the width of the beam for the said angle is wider at 90^0 .The slope for 20^0 & 180^0 for both algorithm is same as with 10^0 and 90. The slope of BER without beamforming is almost flat.

Considering Angle for tx1=10° and tx2=90°

	RICIAN channel		RAYELIGH channel		AWGN channel	
	Antenna Angle 10°& 90°					
SNR	Without Beam Forming BER	With Beam forming BER	Without Beam forming BER	With Beam forming BER	Without Beam forming BER	With Beam forming BER
4	0.000982	0.0007291	0.008392	0.0008392	0.0009333	0.0007566
8	0.0009799	0.0006169	0.007101	0.0007101	0.0008825	0.0006402
12	0.0009778	0.0005048	0.00581	0.000581	0.0008317	0.0005048
16	0.0009757	0.0003926	0.004519	0.0004519	0.000781	0.0004074
20	0.0009735	0.0002804	0.003228	0.0003228	0.0007302	0.000291
24	0.0009714	0.0001683	0.001937	0.0001937	0.0006794	0.0001746
28	0.0009693	0.00005608	0.0006455	0.00006455	0.0006286	0.0000582
29	0.0009688	0.00002804	0.0003228	0.00003228	0.0006159	0.0000291

BER is Lowest for angle 10^0 and 90° for RICIAN Channel as Compared to AWGN and Rayleigh channel

Considering Angle for tx1=20° and tx2=180°

	RICIAN channel		RAYELIGH channel		AWGN channel	
	Antenna Angle 20°& 180°					
SNR	Without Beam forming BER	With Beam forming BER	Without Beam forming BER	With Beam forming BER	Without Beam forming BER	With Beam forming BER
4	0.000982	0.0008254	0.000982	0.0008529	0.0009143	0.0007291
8	0.0009799	0.0007217	0.0009799	0.0007217	0.0008444	0.0006169
12	0.0009728	0.0005905	0.0009778	0.0005905	0.0007746	0.0005048
16	0.0009757	0.0004593	0.0009757	0.0004593	0.0007048	0.0003926
20	0.0009735	0.000328	0.0009735	0.000328	0.0006349	0.0002804
24	0.0009714	0.0001968	0.0009714	0.0001968	0.0006349	0.0001683
28	0.0009693	0.00006561	0.0009693	0.00006561	0.0004952	0.00005608
29	0.0009688	0.0000328	0.0009688	0.0000328	0.0004778	0.00002804

BER is Lowest for angle 20^0 and 180° for AWGN Channel as Compared to RICIAN and Rayleigh channel

IV. Conclusion

From the Simulation Result it is found that RICIAN Channel has improved (lowest) BER with lower SNR for Angle **10^0 and 90°**, whereas AWGN Channel has improved (lowest) BER with lower SNR for Angle **20^0 and 180°**.

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