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Bit Error Rate Performance Analysis with Beam forming

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Abstract: In wireless communication system, there exists a problem of fading, due to which sometimes very weak signal will be received on another side resulting in errors in received bits. Bit error rate (BER) should be improved for getting good quality of signal. One of the ways to improve BER is Beam Forming technique. In this paper, the BER is analysed for BPSK in Rayleigh fading channel with 2 or more transmitter antenna and 1 receiver antenna with or without beam forming.

Keywords: MIMO, Multipath, fading, beam forming.

I. INTRODUCTION

In wireless communications, multi-path is the propagation phenomenon that results on radio signals reaching the receiving antenna by two or more paths [2]. Reasons of multi-path incorporate atmospheric ducting, ionosphere reflection, reflection and refraction from terrestrial object such as mountains, buildings or vehicles.

Multiple-input multiple-output (MIMO) wireless technology [1] give the impression to meet these demands by offering improved spectral efficiency through spatial multiplexing gain, and enhanced link reliability due to antenna diversity gain.

In MIMO systems, multiple antennas at both transmitter & receiver and diversity techniques can be used to reduce multi-path fading and interference. Diversity can be achieved by providing a copy of the transmitted signal over frequency, time and space.

II. MIMO

This requires Antenna arrays at the transmitter and receiver to enhance the system capacity on frequency selective channels resulting in a Multiple Input Multiple Output (MIMO) configuration. As there are several antennas at receiver and transmitter, MIMO systems can be employed for diversity. This spatial multiplexing method transmits several parallel information streams at same transmit power [4].

The principle of diversity is to provide the receiver with multiple versions of the same signal. If these can be made to be affected in different ways by the signal path, the probability that they will all be affected at the same time is considerably reduced. Accordingly, diversity helps to stabilize a link and get better performance, reducing error rate.

Several different diversity modes are available and provide a number of advantages:

- **Time diversity:** In time diversity a message can also be transmitted making use of distinct timeslots and channel coding at distinctive times.
- **Frequency diversity:** Different frequencies are used in this diversity. It can be within the style of making use of specific channels, or technologies such as spread spectrum / OFDM.
- **Space diversity:** Antenna diversity, also known as area variety or spatial range. It is any individual of numerous Wi-Fi variety systems that uses greater than two antennas to support the high-quality and consistency of a wireless link.

III. BEAM FORMING

Beam forming consists of transmitting the same signal with different gain and phase over all source antennas such that the receiver signal is maximized [3]. A beam former appropriately combines the signals received by the different elements of an antenna array to form a single output.
Beam forming - A transmitter receiver pair can perform beam forming and direct their main beams at each other, thereby increasing the receiver's received power and consequently the SNR.

IV. SIMULATION RESULTS

In this paper, we have simulated beam forming for numerous transmit and receive antenna over Rayleigh fading channel.

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TABLE 1 MISO system comparison in with beam forming or without beam forming (2Tx-1Rx)

SNR (db)	Result with beam forming (2Tx-1Rx) (BER)	Result without beam forming (2Tx-1Rx) (BER)
0	0.067167	0.146850
5	0.014611	0.064322
10	0.002004	0.023374
15	0.000255	0.007631
20	0.000018	0.002456
25	0.000005	0.000758
30	0	0.000196
35	0	0.000087

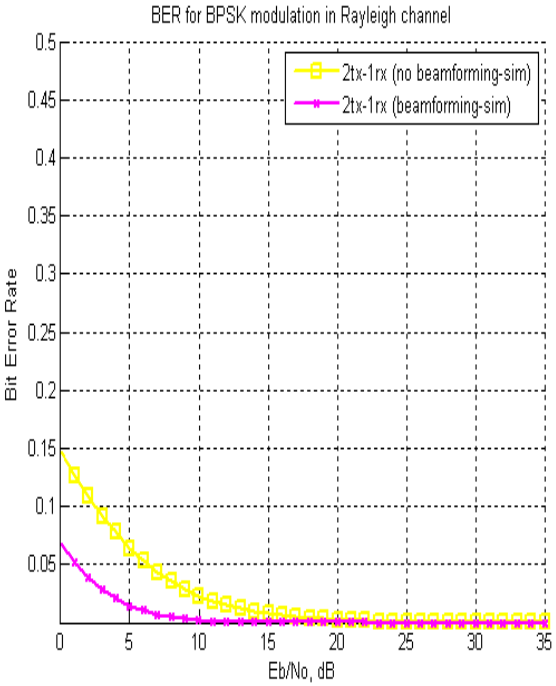

Fig1: BER OF MISO WITH AND WITHOUT BEAM FORMING (2Tx-1Rx)

Fig 1 shows the BER performance curve of BPSK modulation scheme for 2 transmit antennas and one receive antenna under Rayleigh fading environment. Table 1 shows the values of BER for different value of SNR with or without Beam forming. . From Fig 1 and Table 1, it can be shown that with increase in SNR results in decrease in BER and beam-forming provides better results.

TABLE 2 MISO system comparison in with beam forming or without beam forming (3Tx-1Rx)

SNR (db)	Result with beam forming (3Tx-1Rx)(BER)	Result without beam forming (3Tx-1Rx)(BER)
0	0.032834	0.146850
5	0.003707	0.064322
10	0.000214	0.023374
15	0.000006	0.007631
20	0	0.002456
25	0	0.000758
30	0	0.000196
35	0	0.000087

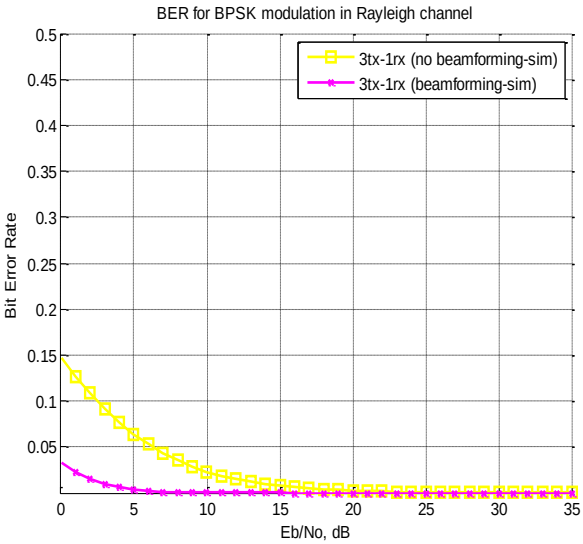

Fig 2: BER OF MISO WITH AND WITHOUT BEAMFORMING (3TX-1RX)

Fig 2 shows the BER performance curve of BPSK modulation scheme for 3 transmit antennas and one receive antenna under Rayleigh fading environment. Table 2 shows the values of BER for different value of SNR with or without Beam forming. . From Fig 2 and Table 2, it can be shown that with increase in SNR results in decrease in BER and beam-forming provides better results.

TABLE 3 MISO system comparison in with or without beam forming (4Tx-1Rx)

SNR (db)	Result with beam forming (4Tx-1Rx)(BER)	Result without beam forming (4Tx-1Rx)(BER)
0	0.016559	0.146850
5	0.000928	0.064322
10	0.000011	0.023374
15	0	0.007631
20	0	0.002456
25	0	0.000758
30	0	0.000196
35	0	0.000087

Fig 3 shows the BER performance curve of BPSK modulation scheme for 4 transmit antennas and one receive antenna under Rayleigh fading environment. Table 3 shows the values of BER for different value of SNR with or without Beam forming. . From Fig 3 and Table 3, it can be shown that with increase in SNR results in decrease in BER and beam-forming provides better results.

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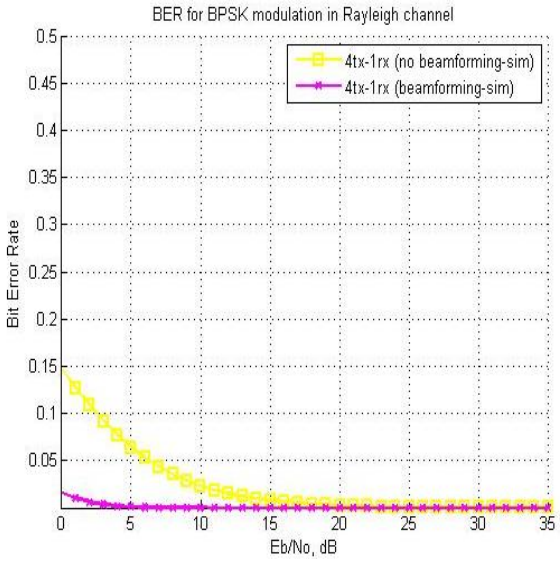

Fig3-BER OF MISO WITH AND WITHOUT BEAMFORMING (4TX-1RX)

TABLE4 MISO system comparison in with beam forming or without beam forming (5Tx-1Rx)

SNR (db)	Result with beam forming (5Tx-1Rx)(BER)	Re sult without beam forming (5Tx-1Rx)(BER)
0	0.008674	0.146850
5	0.000246	0.064322
10	0.000002	0.023374
15	0	0.007631
20	0	0.002456
25	0	0.000758
30	0	0.000196
35	0	0.000087

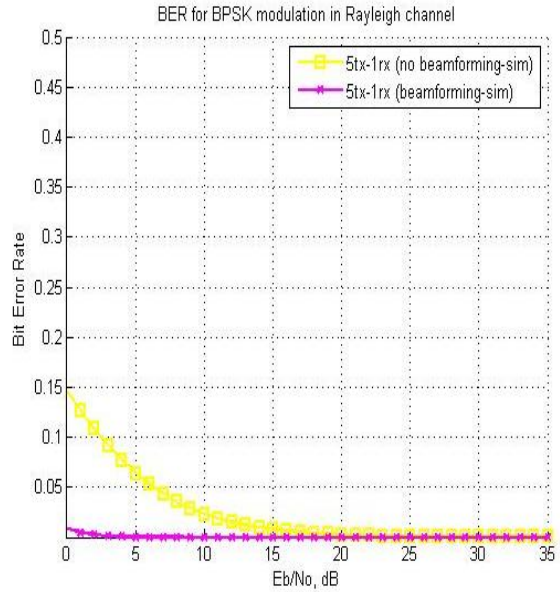

Fig4-BER OF MISO WITH BEAM FORMING AND WITHOUT BEAM FORMING (5TX-1RX)

Fig 4 shows the BER performance curve of BPSK modulation scheme for 5 transmit antennas and one receive antenna under Rayleigh fading environment. Table 4 shows the values of BER for different value of SNR with or without Beam forming. . From Fig 4 and Table 4, it can be shown that with increase in SNR results in decrease in BER and beam-forming provides better results.

V. CONCLUSION

From simulation investigations it has been concluded that beam-forming increases the signal strength at the receiver thereby improving the BER. It can also be observed that by increasing the number of transmitting antenna the performance of MISO system becomes better.

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