BER Performance Evaluation of Divergent Diversities Schemes in Wireless System

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Abstract

Any wireless transmission systems have superior quality and coverage, power and bandwidth efficient and can be implemented in diverse environments. However, mostly, the wireless transmission channel endures from attenuation because of destructive and constructive count of multi-path in the propagation media. This means that severe attenuation in a multipath wireless environment makes it extremely difficult for the receiver to determine the transmitted signal unless the receiver is provided with some form of diversity, i.e., some less-attenuated replica of the transmitted signal is provided to the receiver. This paper presents BER evaluation of divergent diversities technique for wireless networks that use multiple numbers of antennas at both transmitter and receiver. The transmitter, receiver and MIMO diversities are implemented and tested.

Keywords— *Maximal Ratio Combining (MRC), MIMO, Transmitter diversity, Receiver diversity*

I. INTRODUCTION

In wireless communication, the transmitting information is riding on radio (electromagnetic) waves and hence the information undergoes attenuation effects (fading) of radio waves. These attenuation effects could also vary with time due to user mobility, making wireless a challenging communication medium. It is tremendously random and complicated to analyze since the signal transmitted over wireless channel appears at the receiver in a numerous path or multipath [1].

This is arises due to scattering, reflection, diffraction or refraction of transmitted radiated energy. The essentially received signal is habitually weaker than transmitted signal due to propagation loss and fading. Multipath Fading is known to arise due to the non-coherent combination of signals arriving at the receiver antenna [2]. Typically, this phenomenon is described as the constructive/destructive interference between signals arriving at the same antenna via different paths, and hence, with different delays and phases, resulting in random fluctuations of the signal level at the receiver. Deep-fades that may occur at a particular point in space, or at a particular time or frequency, result in severe degradation of the quality of signals at the receiver making it impossible to detect and decode. The following factors persuade fading [3]:

A. *Multi-path Propagation*

It is a situation where the transmitted signal is reflected or diffracted or scattered by physical structure. Therefore produce multiple signal paths between transmitter and receiver station. This effect produces fading and distortion on received signal.

B. *Speed of the Mobile*

The relative motion between the base station and the mobile is result in random frequency modulation due to different Doppler shifts on each of the multi-path components.

C. *Speed of the Surrounding Objects*

If the surrounding objects in motion they induce Doppler shift on multi-path components.

D. *Transmission Bandwidth of the Signal*

If transmitted signal bandwidth is greater than the multi-path channel bandwidth, a distorted signal received. The channel bandwidth quantified by the coherence bandwidth [3-4].

II. ALAMOUTI SCHEME (2TX, 1RX)

M. Alamouti [5] in his landmark paper offers simple methods to achieve spatial diversity with two transmit antennas and one receive antenna. The encoding of signal is done in space and time (space–time coding). Instead of two adjacent symbol periods, two adjacent carriers may be used (space–frequency coding). Consider we have a transmission sequence e.g. x1, x2, x3.....xn. In normal transmission, we send x1 in first time slot, x2 in second time slot and so on. However, Alamouti suggested that group the symbols into the group of two. In the first time slot send x1 and x2 from first and second antenna and –x2* and x1* from first and second antenna at second time slot. In third time slot x3 and x4 from first and second antenna and there conjugates in fourth time slot and so on. Now the signal is transmitted through various channels. The channel experience by each transmit antenna is independent from the channel experienced by another antennas [6]. However the channel is assumed to remain constant over two time slots. G2 represents a code which utilizes two transmit antennas and is defined by:

$$G2=\begin{pmatrix} x_1 & x_2 \\ -x_2^* & x_1^* \end{pmatrix}$$

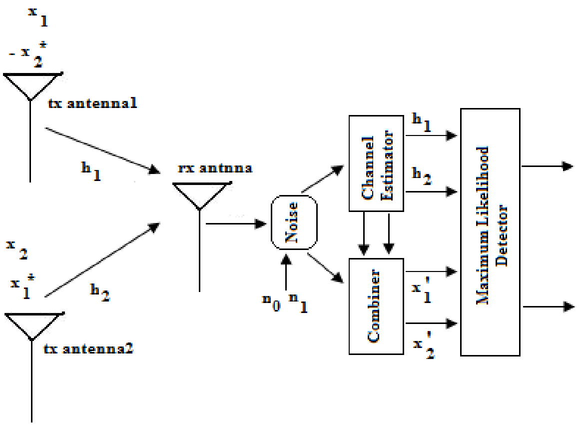

Fig. 1: Simple 2Tx Diversity Scheme with 1Rx

In the first time slot, the received signal is: y1=h1x1 + h2 x2 + n0. In second time slot the received signal is: y2=-h1x2* + h2 x1*+n1

Combining scheme

X1'=h1* y1+h2*y2

X2'=h2*y1+h1*y2

These combined signals are then sent to maximum likelihood detector. There are many applications where higher order of diversity is needed and multiple receive antennas at the remote unit is feasible [7-8]. In such cases, it is possible to provide a diversity order of 2M with two transmit and M receive antenna.

III.RESULT & DISCUSSION

Transmitter diversity (MISO) in transmission systems utilizes multiple antennas (Nt) at the transmitter and a single antenna at the destination (receiver). Receiver diversity (SIMO) in transmission systems utilizes one antenna at the transmitter and multiple antennas at the receiver. Thus, any transmitted from the only transmit-antenna will arrive at all receiver antennas through different sub-channels.

The performance of the system under receiver diversity is evaluated in terms of graph between BER and SNR. The BER performance is evaluated for no diversity and receiver diversity under BPSK modulation is shown in figure 1. The Transmitter diversity under QPSK modulation is shown in figure 2.

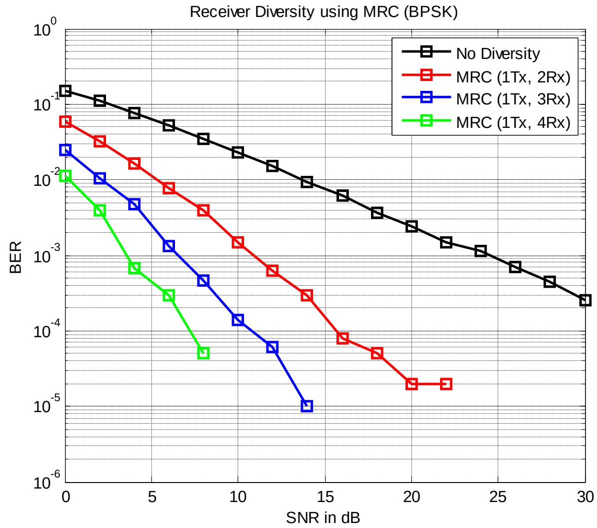

Fig. 2: BER of Transmitter Diversity under BPSK

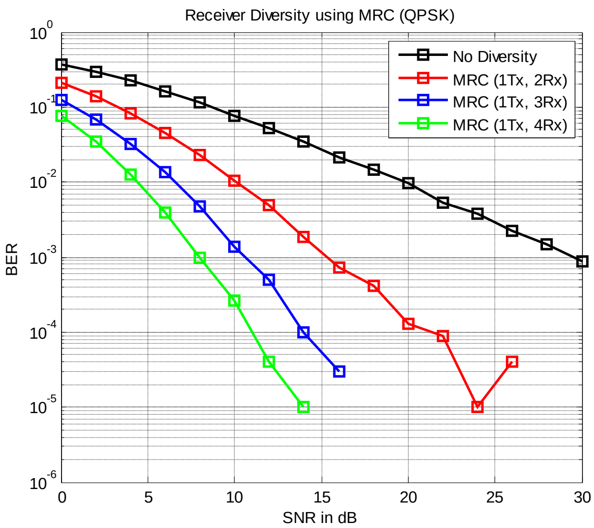

Fig. 3: BER of Receiver Diversity under QPSK

The BER of MIMO diversity technique for divergent configuration (4Tx and M Rx) is evaluated and is shown in figure 4.

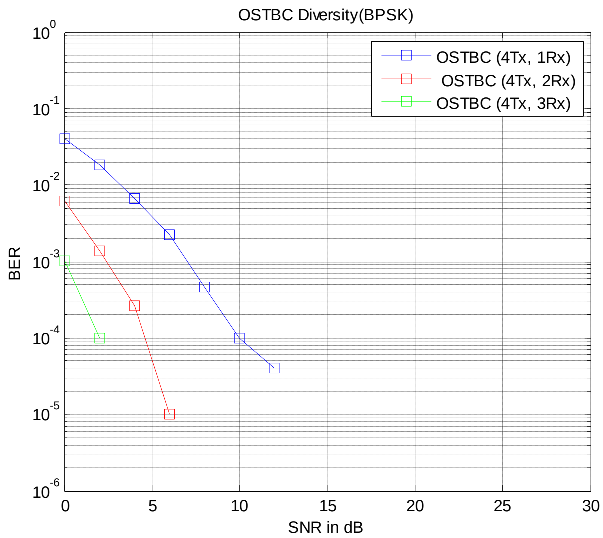

Fig. 4: BER of OSTBC Diversity under BPSK

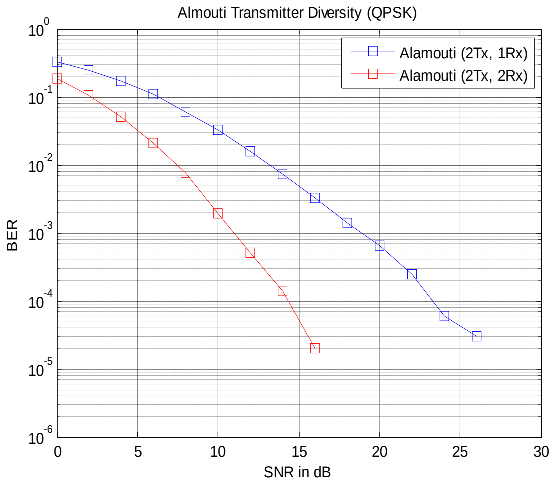

Fig. 5: BER of OSTBC Diversity under QPSK

IV. CONCLUSIONS

The Transmitter diversity, receiver diversity and MIMO model is tested with divergent configuration. The BER of the developed system improves when incorporated diversity schemes in system. Receiver Diversity using MRC improves BER compared to Transmitter diversity. The increase of antenna in transmitter or receiver, BER improves but at the same time complexity and cost increase. BPSK modulation gives better result as compare other PSK modulation schemes like QPSK.

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