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Analysis of BER for V- BLAST MIMO System using MMSE using MATLAB

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ABSTRACT:

Equalization compensates for Inter-Symbol Interference created by multipath within time dispersive channels. In the V-BLAST (Vertical-Bell LaboratoriesLayered Space-Time) algorithm was reviewed and the error propagation of this algorithm is investigated. This work analyzes and improvement, the performance of MMSE for 2*2 MIMO systems with Rayleigh flat fading wireless channels. The simulation results are obtained using MATLAB R2013a. The Bit Error Rate (BER) characteristics for the 2- transmitting and 2 receiving antenna simulates in MATLAB and describes many advantages and disadvantages of the system. The simulation results show that the equalizer based MMSE (Minimum Mean Squared Error) receivers is good for noise free channel and is successful in removing ISI, the simulation results shown between BER verses SNR in dB.

***Keywords*:** AWGN, BER, Fading Channel, MMSE.

I. Introduction

In mobile communications systems, data transmission at high bit rates is essential for many services such as video, high quality audio and mobile integrated service digital network. When the data is transmitted at high bit rates, over mobile radio channels, the channel impulse response can extend over many symbol periods, which lead to Inter-symbol interference (ISI). Inter-symbol Interference always causes an issue for signal recovery in wireless communication. This can be combated with application of an equalizer. Equalization compensates for Inter-symbol Interference (ISI) created by multipath signal prorogation within time dispersive channels [1]. Wireless system designers are continuously facing the increasing demand for mobility required and high data rates by new applications and that's why they have started research on fifth generation wireless systems that are expected to be employed beyond 2020. 5G technology stands for fifth generation mobile technology which is the standard beyond 4G and LTE-advanced.

MOST recently, MIMO is one of the most attractive techniques in wireless communication that uses multiple antennas at both transmitter and receiver and provides improved BER, or data rate compared to conventional communication systems [2, 3, 4]. MIMO has eminent features which offer significant increment in data throughput and link range without additional bandwidth and increase transmit power. Modern wireless communication standards such as IEEE 802.11n (Wi-Fi), 4G, 3GPP Long Term Evolution (LTE) and WiMAX has become an important part due to these properties [4-5]. In MIMO wireless communication, multipath fading is a usual pphenomenon that causes ISI in the transmitted signal. To remove ISI from transmitted signal, BER reduction is compulsory [4].

II. V-Blast

V-BLAST (Vertical-Bell Laboratories Layered Space-Time) is a detection algorithm to the receipt of multi-antenna MIMO systems.Available for the first time in 1996 at Bell Laboratories in New Jersey by Gerard J. Foschini. He proceeded simply to eliminate interference caused successively issuers.Spatial multiplexing is transmission technique in MIMO wireless communication to transmit independent and separately encoded data signals. Therefore, the space dimension is reused, more than one time. V-BLAST is one of the better techniques of spatial multiplexing. Although-BLAST is essentially a single-user system which uses multiple transmitters, one can naturally ask in what ways the BLAST approach differs from simply using traditional multiple access techniques in a single-user fashion, i.e.by driving all the transmitters from a single user's data which has been split into sub streams. Some of these differences are Worth pointing out: First, unlike code division or other spread-spectrum multiple access techniques, the total Channel bandwidth utilized in a BLAST system is only a small fraction in excess of the Symbol rate, i.e. similar to the excess bandwidth required by a conventional QAM system. Finally, unlike TDMA, the entire system bandwidth is used simultaneously by all of the transmitters all the time. Taken together, these differences together are precisely what give BLAST the potential to realize higher spectral efficiencies than the multiple-access techniques. In fact, an essential feature of BLAST is that no explicit orthogonalization of the transmitted signals is imposed by the transmit structure at all.

III. Equalizer Technique

Equalization is the technique which is used to mitigate the effect of the ISI (inter symbol interference) by minimizing the error probability occur in the communication system without ISI suppression method. Since, suppression of ISI causes the noise power to enhanced therefore it is essential to create optimum balance between enhancement of noise power and suppression of ISI [6], One of the practical problems in digital communications is inter-symbol interference (ISI), which causes a given transmitted symbol to be distorted by other transmitted symbols. One of the most commonly used techniques to counter the channel distortion (ISI) is linear channel equalization. Conventional equalization techniques employ a pre-assigned time slot (periodic for the time-varying situation). In the receiver the equalizer coefficients are then changed (e.g. LMS, MMSE, etc.).

III. (A) Adaptive equalization

An adaptive equalizer is a kind of digital filter or equalization filter which is designed to automatically adapts itself to the time varying characteristics of communication channel. This technique is most often used to mitigate the distortion caused by multipath effect [6, 7].

1.7.2 Zero Forcing Equalizer

Proposed by Robert lucky, zero forcing method of equalization is a linear equalization method in which restoration of the transmitted signal is carried by inverting the frequency response of the channel. The name zero forcing comes from the fact that it is able to decrease the ISI level to zero value under the noise free environment. This technique of equalization is useful for the channel where the ISI is more significant than the noise [6].

IV. Simulation results for MMSE Equalizers

In this section results are shown in terms of Bit Error Rate (BER) with respect to variation in SNR for 2X2 MIMO-V-BLAST system using BPSK modulation techniques and MMSE, MMSE-SIC and MMSE-SIC-Sort equalisation algorithms under Rayleigh channels.

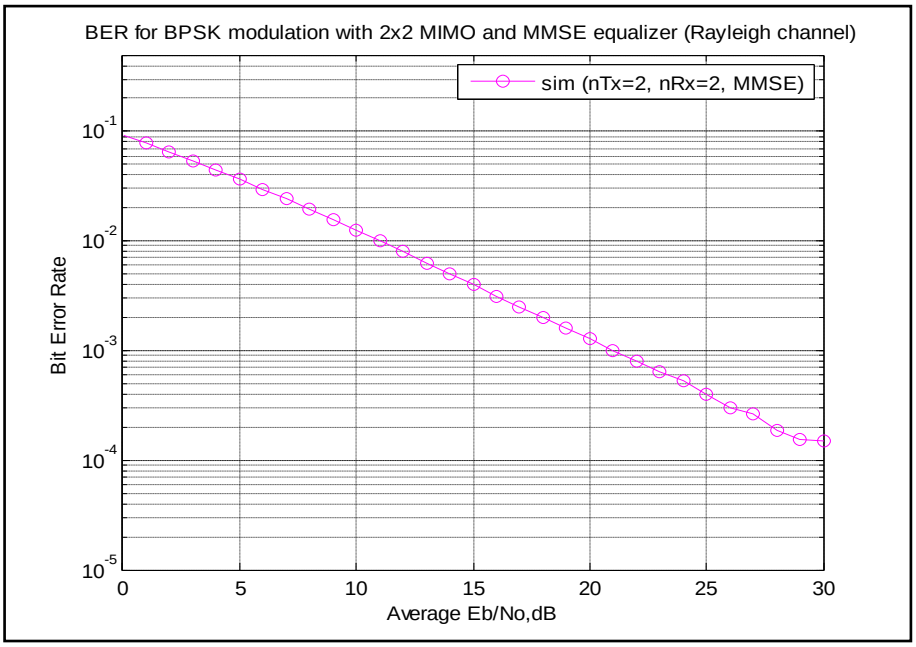

Fig. 1: Simulation Results for BPSK modulation with 2×2 MIMO with MMSE

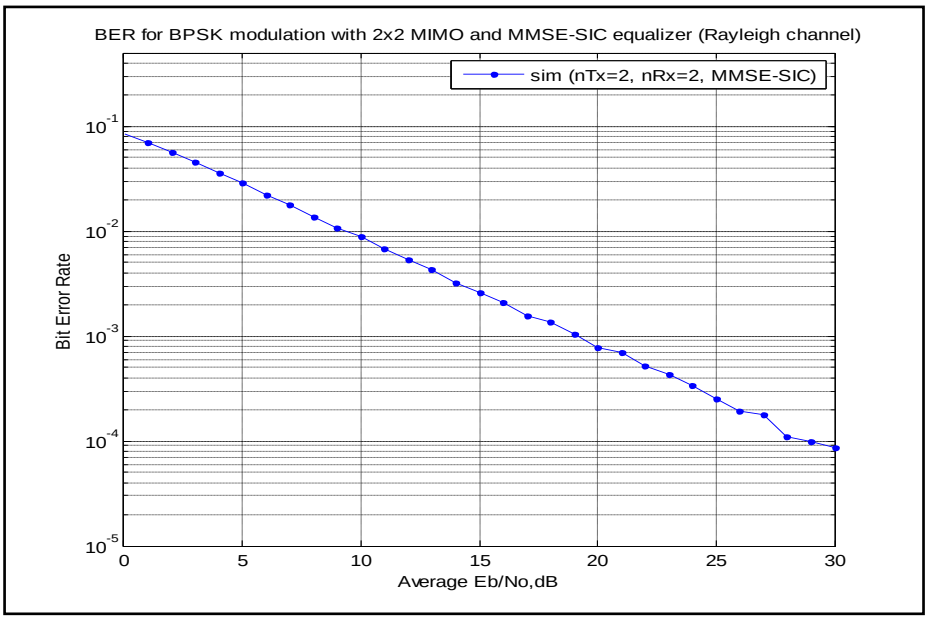

Fig. 2: Simulation Results for BPSK modulation with 2×2 MIMO with MMSE-SIC

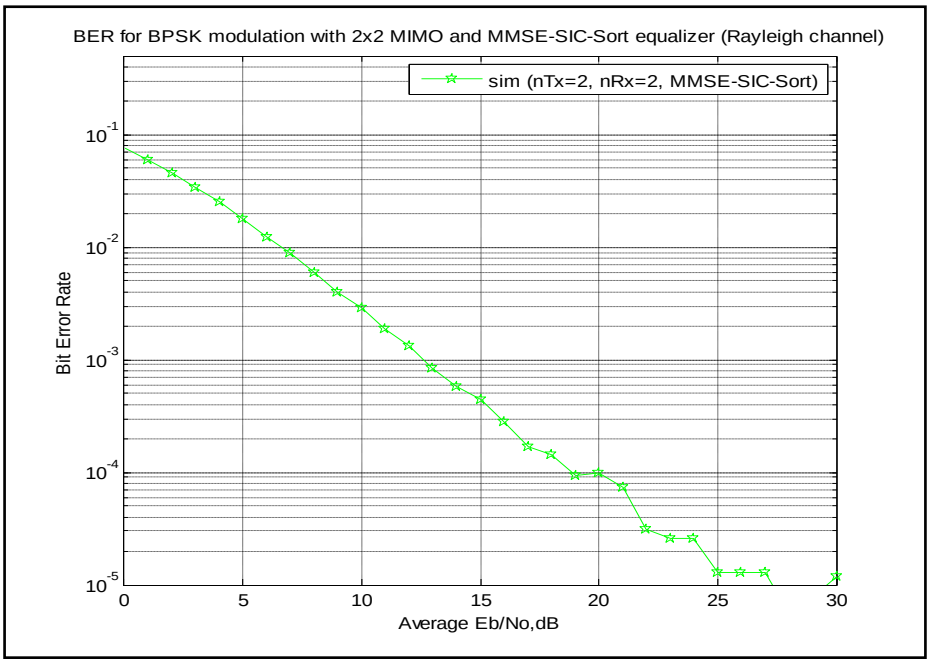

Fig. 3: Simulation Results for BPSK modulation with 2×2 MIMO with MMSE-SIC-Sort

Conclusion:

The BER values have been computed as a function of SNR for BPSK modulation and different combinations of MIMO systems using MMSE, MMSE-SIC and Modified MMSE-SIC-Sort, and ML equalizers. The simulations studies have been carried out using MATLAB software. In the above result observed that MMSE-SIC-Sort has reduced error at all the point of SNR range 0 to 27dB.

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