

Space-Time Block Coding

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Abstract: The Space Time Coding has proven to be an evolved research area in wireless communications. Recently, Space-Time Block Coding (STBC) has been trying to incorporate in the forthcoming generation of mobile communication standard with aims to deliver true media capability. This paper presents the Space-Time Block Coding (STBC) for wireless networks that uses multiple number of antennas at both transmitter and receiver to transmit and receive data over various channels (Rayleigh and Rician). The simulations have been done in SIMULINK. Different modulation schemes (DPSK and BPSK) have been adopted to check the performance of the system via Bit Error Rate Vs Signal to Noise Ratio.

Keywords: Alamouti scheme, BER Vs SNR, BPSK, DPSK, Rayleigh, Rician.

Date of Submission: 23-10-2017

Date of acceptance: 11-11-2017

I. Introduction

The demand for higher data rates over wireless channel using the spectrum allotted by the federal government is the need of the hour today. However, the wireless designers need to take care of increase in battery life by making the product small and less power consuming. The randomness of the wireless channel makes it difficult for the designers to increase data rate [1][2][9], to manage the constraints. A major problem in the wireless channel is that of fading, caused by the superposition of delayed, reflected, scattered and diffracted signal components. Another problem of the wireless channel is variation over time, due to the movements of the mobile unit and [3] [4] objects in the environment. This result into severe attenuation of the signal, referred to as deep fade. This instantaneous decrease of the signal-to-noise ratio (SNR) results in error bursts which degrades the performance significantly. In such fading environments, reliable communication is possible through the use of diversity techniques in which receiver is afforded multiple replicas of the transmitted signal under varying fading conditions. These techniques reduce the probability that all the replicas are simultaneously affected by a severe attenuation. Commonly used methods include [6] [7]:

1. Frequency Diversity, in which the signal is transmitted on multiple RF carriers.
2. Temporal Diversity, in which channel coding and inter leaving are used to replicate and distribute the signal in time.
3. Antenna/ Spatial Diversity, in which multiple antennas are used at the transmitter and/or the receiver to provide multiple replicas of the signal with uncorrelated fading characteristics.

It has been proved by the informative investigations that very high capacity can be obtained by employing multiple antenna elements at both transmitted and receiver of a wireless system. The approach of Space-Time Coding uses multiple transmit antennas and (optionally) multiple receive antennas to provide high data rates and reliable communications over fading channels by combining spatial diversity, coding and modulation. Examples of space-time coding include space-time block codes, space-time trellis codes, linear-dispersion (LD) codes and super-orthogonal space-time codes. Space-time trellis code provide full diversity and coding gain at the cost of a complex receiver. Space-time block codes provide full diversity and simple decoding without any coding gain. Like STC, Bell Laboratories Layer Space-Time (BLAST) [8][9][10] is a transceiver architecture that offers spatial multiplexing over multiple antenna wireless communication systems. Both the techniques employ the space (different antennas) and the time domain while encoding and decoding information symbols. Hence, the terms multiple-input and multiple-output (MIMO) and space time coding can be used interchangeably.

To transmit symbols from multiple antennas, a technique is used which is known as Space-time signaling. Schemes which use multiple transmit and receive antennas for communicating over a wireless channel are usually called Multiple-input multiple-output (MIMO) schemes. For effective evaluation of the performance of a MIMO transmission scheme, certain models are required in order to account for all the major effects of wireless channel on various signals. The most commonly used channel model for MIMO systems is quasi-static at Rayleigh fading [12] at all antenna elements. This was employed in where novel signal processing

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