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New Trend of Space-Frequency Block Code-OFDM

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Abstract:

To avoid the problem of fast channel variations in time, the symbols of an orthogonal design can be transmitted on neighboring subcarriers of the same Orthogonal Frequency Division Multiplexing (OFDM) symbol rather than on the same subcarrier of the subsequent OFDM symbols. This also reduces the transmission delay. Space-Frequency Block Codes (SFBC) avoids the problem of fast time variations. A new trend of SFBC introduced and examined for flat and frequency-selective channels over various values of Doppler frequencies and various type of modulation (QPSK, 8-PSK, 16-QAM and 32-QAM). Alamouti code was applied to a block of the odd and even elements instead of one symbol. The performance comparisons of bit error probability for the conventional SFBC-OFDM and the proposed one have been presented. As a result, it can be concluded that the proposed structure achieves much lower bit error rates. MATLAB version 7.4 had been used as a simulation tool.

Keywords- STC, SFBC, OFDM.

Introduction

The wireless channel mainly suffers from time-varying fading due to multipath propagation and destructive superposition of signal received over different paths, which make it hard for the receiver to reliably determine the transmitted signal unless some less attenuated replica of the signal are provided to the receiver. Transmitting the replica of the signal is called diversity. A widely applied technique to reduce the effects of multipath fading is antenna diversity [1].

Space-Time Codes (STC) were first introduced by Tarokh et al. from AT&T research Labs. in 1998 as a novel means of providing transmit diversity for multiple antenna fading channel. They generalized the transmission scheme to an arbitrary number of transmit antennas, which can achieve the full diversity promised by the transmit and receive antennas [2,3].

Alamouti (1998) proposed Initial and simple examples of implementation of space-time coding, two-branch transmit diversity scheme, using two transmit antennas and one receive antenna. STBC was first proposed by Alamouti for flat fading channels. Alamouti introduced a code named Alamouti code which shown below [4]:

$$\begin{bmatrix} X(i) \\ X(i+1) \end{bmatrix} = \begin{bmatrix} X(i) & -X^*(i+1) \\ X(i+1) & X^*(i) \end{bmatrix} \begin{matrix} \rightarrow time \\ \downarrow space \end{matrix}$$

Orthogonal frequency-division multiplexing (OFDM) is an excellent technique to reduce the effect of frequency-selective fading by dividing the transmission bandwidth into many narrow-band subcarriers, each of which exhibits an approximately flat fading[5,6].

Naderi and Pourmina [7] investigated the suitability and performance of space-frequency block codes under UWB channel and for a Multi-Band Orthogonal Frequency Division Multiplexing (MBOFDM) System, and concluded that space-frequency block codes provide

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