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Space Time Trellis Codes Performance with OFDM System

[1]Pappu Singh Patel, [2]Rohit Shrivastava, [3]Md. Sarwar Raeen

[1,3]Department of ECE, All Saints' College of Technology,Bhopal,M.P.,India.
[2]Asst. Prof, E.C.E. Dept, Oriental Collegeof Technology,Bhopal(M.P.),India.
Corresponding Email : er.pappusingh@gmail.com

Abstract— The system performance is generally improved by coding. Here we are going to implement trellis coded modulation with OFDM system which consists of two transmitters and a single receiver. An M-ary PSK modulation is used to modulate the symbols across an OFDM channel. Additive white Gaussian noise channel is considered throughout the analysis. Bit error rate performance of the above systems is carried-out with emphasis on the modulation scheme, no. of carriers and bit SNR.
Keywords: Space time coding, OFDM, frequency-selective channel.

1. INTRODUCTION

The accomplishment of high data rate reliable transmission over wireless channels is possible only when Space-time codes came in existence. Space-time codes are based on transmits diversity and is particularly suitable when the signal undergoes frequency flat fading due to the channel. This paper discusses the performance of the OFDM with space time trellis coded modulation. Following the introduction this paper is organized as under Section 2 describes the space time trellis coded modulation. Section 3 describes about OFDM. Section 4 describes about performance analysis. Section 5 describes the simulation result. Section 6 provides concluding remarks.

2. Space Time Trellis Coded Modulation

Space-Time Trellis Codes (STTCs) were introduced in 1998 [1] as a high- data rate, bandwidth and power-efficient method of communication over wireless Rayleigh and Rician fading channels. STTCs can achieve a diversity advantage by placing the diversity burden on the base station, and hence leaving the mobile station to maintain its mobility and practicality [1].

STTCs are totally based on well defined trellis structures and hence they can be decoded using soft-decision decoding techniques at the receiver, such as Viterbi decoding. STTC modulation proposed a joint design of coding, modulation, and transmits diversity for flat Rayleigh fading channels.

Trellis coded modulation (TCM) is a technique that combines error-correcting coding and modulation in digital communications [2].TCM gains noise immunity over un-coded transmission without any increase in the signal bandwidth or the transmission power. By partitioning signal set into groups, TCM uses signal mapping to increase the Euclidean distance, rather than the Hamming distance, between codes [3],[4]. TCM systems use 2^{m+1} constellation points for transmitting m bits. In [5], a systematic approach to partition multidimensional signals is proposed. Since iterative error correction codes (ECCs) such as turbo codes [6] and low-density parity-check codes [7] are popular due to their near-Shannon limit decoding performance, TCM has the advantage of low decoding latency over these iterative codes. In this paper, an encoder and Viterbi decoder are implemented to simulate the performance of space time trellis coded modulation in a second order diversity (two transmit and one receive antennas).

3. Orthogonal Frequency Division Multiplexing

Orthogonal frequency division multiplexing (OFDM) is a popular technique for transmission of signals over wireless channels. OFDM has been adopted in several wireless standards such as digital audio broadcasting (DAB), digital video broadcasting (DVB-T), the IEEE 802.11a [8] local area network (LAN) standard and the IEEE 802.16a [9] metropolitan area network (MAN) standard. OFDM is also being pursued for dedicated short-range communications (DSRC) for road side to vehicle communications and as a potential candidate for fourth-generation (4G) mobile wireless systems. OFDM converts a frequency-selective channel into a parallel collection of frequency flat subchannels. The subcarriers have the minimum frequency separation required to maintain orthogonality of their corresponding time domain waveforms, yet the signal spectra corresponding to the different subcarriers overlap in frequency. Hence, the available bandwidth is used very efficiently. If knowledge of the channel is available at the transmitter, then the OFDM transmitter can adapt its signaling strategy to match the channel. Due to the fact that OFDM uses a large collection of narrowly spaced subchannels, these adaptive strategies can approach the ideal water pouring capacity of a frequency-selective channel. In practice this is achieved by using adaptive bit loading techniques, where different sized signal constellations are transmitted on the subcarriers.

OFDM is a block modulation scheme where a block of N information symbols is transmitted in parallel on N subcarriers.The time duration of an OFDM symbol is N times larger than that of a single-carrier system. An OFDM modulator can be implemented as an inverse discrete Fourier transform (IDFT) on a block of N information symbols followed by an analog-to-digital converter (ADC). To mitigate the effects of inter symbol interference (ISI) caused by channel time spread, each block of N IDFT coefficients is typically preceded by a cyclic prefix (CP) or a guard interval consisting of G samples, such that the length of the CP is at least equal to the channel length. Under this condition, a linear convolution of the transmitted sequence and the channel is converted to a circular convolution. As a result, the effects of the ISI are easily and completely eliminated. Moreover, the approach enables the receiver to use fast signal processing transforms such as a fast Fourier transform (FFT) for OFDM implementation [10]. Similar techniques can be employed in single-carrier systems as well, by preceding each transmitted data block of N length by a CP of length , while using frequency-domain equalization at the receiver.

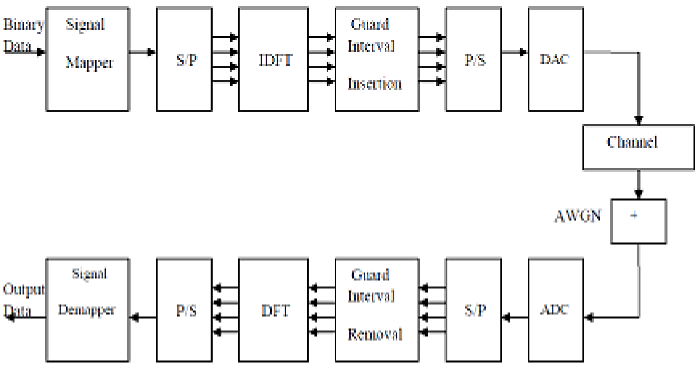

Fig. 1: The basic block diagram of an OFDM system in AWGN Channel

4. Performance Analysis

In previous sections we have discussed the trellis coded modulation scheme and orthogonal frequency division multiplexing, now to analysis the performance of our desired system we have to combine both trellis coded modulation and OFDM system to get our desired result.

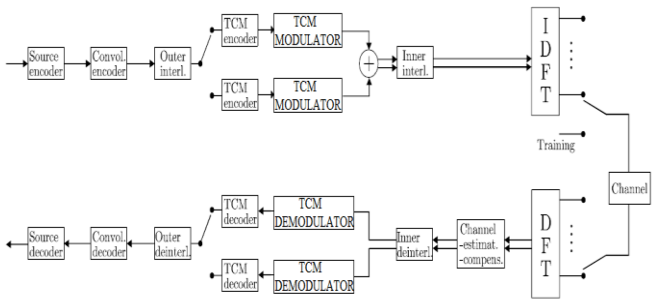

Fig. 2: OFDM Transmitter and Receiver with Trellis Coded Modulation

The basic aim of our work is to reduce the Bit error rate (BER). We are also trying to improve the signal-to-noise ratio in the proposed algorithm. The OFDM technology we changed was designed by m-PSK mapping for BER reduction and FFT/IFFT blocks. Implementation of the above OFDM transceiver designed for BER reduction carried out over MATLAB 7.8.0.Implementation details are first we randomly generate the data using "randint" function provided in MATLAB for the random generation of data. Encoding of data is carried out by *"Trellis Encoding"*M-PSK modulation which is done with the help of 4 states. After the signal is trellis coded modulated followed by IFFT , we designed a channel for transmission, channel is prepared using *additive white Gaussian noise function. At the receiver side first we t*ake the FFT of noisy received signal followed by the decoding process, *Viterbi Detector* is used for this purpose. Finally we'll calculate the bit error rate by comparing the transmitted bits and the received bits.

5. Simulation Result

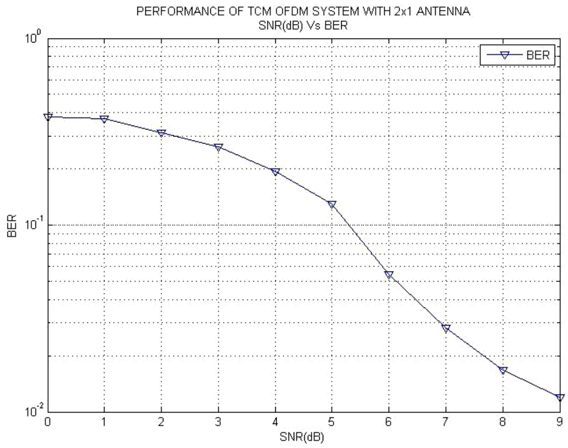

Fig. 3: BER Performance using 4 PSK 4 States TCM OFDM System

6. CONCLUSION

In our paper we combined the trellis coded modulation and OFDM system having two transmitters and one receiver and analysed the performance of system using 4 PSK 4 States modulation which gives the satisfactory result of reduction in bit error rate.

7. REFERENCES

i. *V. Tarokh, N. Seshadri, and A. R. Calderbank, "Space-Time Codes for Wireless Communication: Code construction", IEEE 47th Vehicular Technology Conference, vol. 2, pp. 637-641, Phoenix, Arizona, 4-7 May 1997.*

ii. *E. Bigilri, D. Divsalar, P. J.McLane, and M. K. Simon, Introduction toTrellis-Coded Modulation With Applications. New York: Macmillan,1991.*

iii. *S. G.Wilson, Digital Modulation and Coding. Englewood Cliffs, NJ:Prentice-Hall, 1996.*

iv. *M. Y. Rhee, Error-Correcting Coding Theory. New York: McGraw-Hill, 1989.*

v. *S. S. Pietrobon and R. H. Deng, "Trellis-coded multidimensional phase modulation," IEEE Trans. Inf. Theory, vol. 36, no. 1, pp. 63–89, Jan.1990.*

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vi. *C. Berrou, A. Glavieux, and P. Thitimajshima, "Near Shannon limit error correcting coding and decoding: Turbo codes," in Proc. IEEE ICC, 1993, pp. 1064–1070.*

vii. *D. MacKay and R. Neal, "Near Shannon limit performance of low densityparity check codes," Electron. Lett., vol. 33, no. 6, pp. 457–458, Mar. 1997.*

viii. *Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: High-Speed Physical Layer in the 5 GHz Band, IEEE Standard 802.11a-1999.*

ix. *Local and Metropolitan Area Networks—Part 16, Air Interface for Fixed Broadband Wireless Access Systems, IEEE Standard IEEE 802.16a.*

x. *L. J. Cimini, Jr., "Analysis and simulation of a digital mobile channel using orthogonal frequency division multiplexing," IEEE Trans. Commun., vol. COM-33, pp. 665–675, July 1985.*

xi. *R.W Chang, "Synthesis of Band-Limited Orthogonal Signals for Multi-channel Data Transmission," Bell Syst. Tech., Vol.45, pp.1775-1797, Dec. 1966.*

xii. *R.W Chang, "Orthogonal Frequency Division Multiplexing," U.S Patent 3388455, Jan 6,1970, Filed Nov.4.1966.*

xiii. *S .Weinstein and P. Ebert, "Data Transmission by Frequency Division Multiplexing Using the Discrete Fourier Transform," IEEE Transaction on Communication, Vol.19, and Issue: 5, pp. 628–634, Oct.1971.*

xiv. *G. Ungerboeck, and I. Csajka, "On improving data-link performance by increasing channel alphabet and introducing sequence coding," in Proc. IEEE Int. Symposium on Information Theory (ISIT), Sweden, 1976.*

xv. *V. Tarokh, N. Seshadri, and A.R. Calderbank, "Space-Time Codes for High Data Rate Wireless Communications: Performance Criterion and Code Construction", IEEE Transactions on Information Theory, vol. 44, no. 2, pp. 744-765, March 1998.*

xvi. *D. Agarwal, V. Tarokh, A. Naguib, and Nambi Seshadri, "Space-time coded OFDM for High Data Rate Wireless Communication over wideband," Proc. VTC, Ottawa, Cananda, Vol. 3, pp. 2232-2236, 1998*

xvii. *J. Armstrong, "Analysis of new and existing methods of reducing inter carrier interference due to carrier frequency offset in OFDM," IEEE Trans. Commun., vol. 47, No. 3, pp. 365–369, Mar. 1999.*