International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2013): 4.438

Sparse Fourier Transform for Performance Enhancement on the Basis of MSE and PC

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Abstract: ***The concept of Multiple Input Multiple output (MIMO) with Space Time Block Coding is used for improving the performance of wireless system. Sparse Fourier Transform is developed for estimating the MSE and Pc in system. The design is considered for the AWGN channel. The performance of STBC-MIMO for 8-Quadrature Phase Shift Keying(8-QPSK) is obtained. Furthermore, the proposed algorithm applies with the AWGN channel for estimation. Generally with the increasing value of SNR ,the MSE and BER are reduced. Simulations shows good performance in comparison to existing schemes developed for MIMO systems and it is suitable for m- Nakagami fading.***

Keywords: Sparse Fourier Transform(SFT), AWGN(Additive White Gaussian Noise) , Multiple input multiple output systems (MIMO), Space Time Block Code(STBC), MSE (Mean Square Error), Transient MSE, Nakagami Fading, Pc (Probability of Correct Synchronization)

1. Introduction

To improve the channel capacity and reliability of wireless systems, Space Time Block Codes are used. The digital communication systems generally require a system with diversity technique. It has recently received considerable attention in multiple-input–multiple-output (MIMO) communication systems because of its diversity gain. MIMO systems can attain transmit diversity by employing space–time block coding (STBC) schemes. The STBC for two transmit antennas was first proposed by Alamouti and then, a general framework of STBC by using the orthogonal design theory for different antennas was developed. The STBC schemes can achieve full transmit diversity with the use of maximum-likelihood decoding. The capacity and error probability performance of STBCMIMO have been extensively studied for different fading channel. Based on the smallest distance of the constellation, an expression of the bit error probability (BEP) of the STBC with square quadrature amplitude modulation (QAM) in slow Rayleigh fading channel is derived but needs numerical integration to calculate the value. By using the bit log-likelihood ratio, an analytical expression of the bit error rate (BER) of the STBC with QAM over Rayleigh fading channels is obtained. The error rate performance for the multichannel reception of linearly modulated coherent systems over fading channels is analysed, but the solution is very complicated. The capacity and error probability expressions are also derived for STBC in different fading channels but the BER analysis is restricted to Nakagami-*m* fading channels of integer *m*[5].

2. Proposed Algorithm

The basic wireless design system concept has been always considered with the use of Fast Fourier Transform but Sparse Fourier Transform is also considered in this proposed algorithm.The signal parameters are set as follows. The carrier phase offset φ is chosen to be a random variable uniformly distributed over $[0, 2\pi)$ and the normalized carrier frequency offset F is set to 0.02. For each transmission link, the channel is modelled by a zero-mean independent block m-Nakagami fading. Unless otherwise mentioned, the transmitted data is modulated using quadrature phase shift keying (8-QPSK) with unit variance constellation, and the number of the observed symbols $L = 2N+1$ set to 1025, where N is the FFT[2].

The proposed estimator does not require prior knowledge of the channel coefficients, signal-to-noise ratio (SNR) or the modulation of the transmitted signal. Furthermore, it requires only a rough estimate of the clock timing synchronization. The rest of the paper is organized as follows. Section 2 presents the problem algorithm. The simulation results are provided in Section 3. Finally, conclusions and future scope are discussed in Section 4.

3. Simulation Results

The simulation of proposed approach is explained in this section. The results of the proposed system are calculated in terms of Pc and MSE .The probability of correct block timing synchronization(Pc) and mean square error (MSE) of the estimated normalized carrier frequency offset are used as performance measures. Set of simulations are run for 10,000trials. Figures show Pc and MSE as a function of SNR over m-Nakagami fading channel with m = 2.

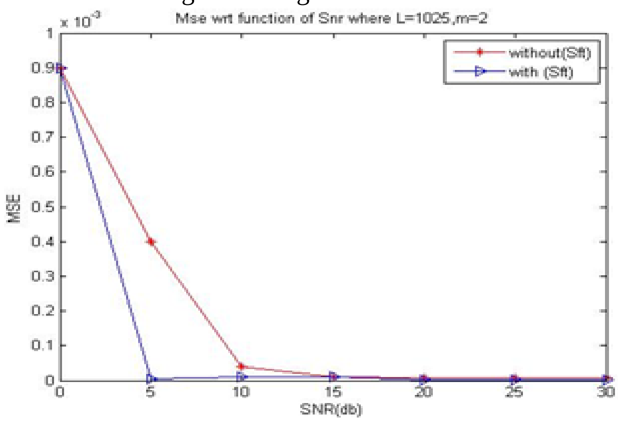

Figure 3.1: MSEwrt function of SNR where m= 2, L=1025

Figure 3.1 illustrates the MSE with respect to the function of SNR where m= 2, L=1025. The results show that the use of SFT proves best as compared to FFT, at minimum of SNR maximum MSE is reduced.

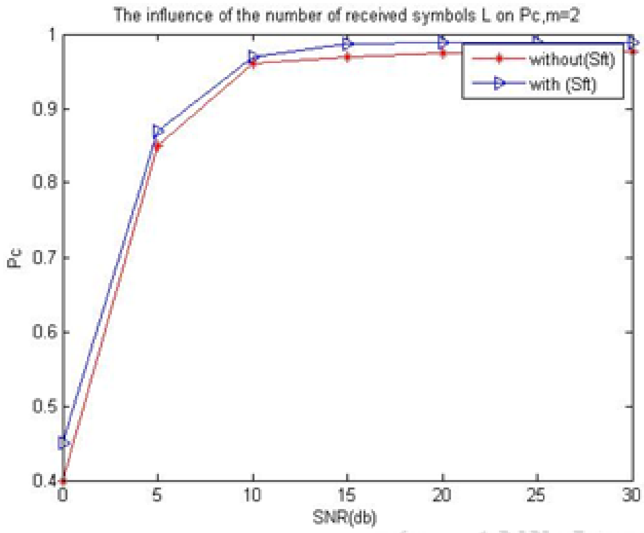

Figure 3.2: The influence of the number of received symbols L on Pc, m=2

Figure 3.2 illustrates the influence of the number of received symbols *L* on *Pc* and MSE at *m* = 2. Pc is approaching towards 1 with SFT. Significant improvements in *Pc* and MSE are observed.

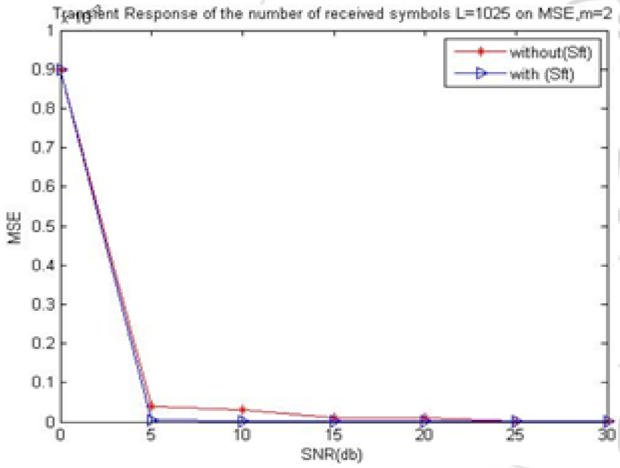

Figure 3.3: Transient response of the number of received symbols L=1025 on MSE, m=2

Figure 3.3 shows the transient response of the number of received symbols (L=1025) MSE , m=2. Here also, the SFT enhances the performance of system.

4. Conclusion

In this paper, Sparse Fourier Transform is proposed after Fast Fourier Transform. It is shown that with the use of Sparse Fourier Transform the better results are achieved in case of MSE and Pc. The simulation result shows that at minimum SNR, maximum reduced value of MSE and Pc are obtained. The future work aims towards that the SFT can be fused with different modulation techniques and for increasing values of m.

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