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Impact Analysis and Comparison of Code Block Size and Radius Ratio on TAPSK Modulation

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Abstract— Non-coherent detection gives straight forward receiver construction modeling then coherent detector considering the fact that it doesn't oblige carrier phase tracking or synchronization. Likewise since non-coherent demodulators/detectors meets expectations uniquely in contrast to coherent it encourages the use of multilevel non-coherent block coding which gives a greater error correcting limit at higher coding efficiency. The detailed analysis on Non-coherent system demonstrates that the coding efficiency can be further enhanced by expanding the base non-coherent distance between the modulation consolations. This outcome the improvement of new modulation strategy derived from MPSK and named as TAPSK (Twisted Amplitude Phase Shift Keying). This result the development of new modulation technique derived from MPSK and named as TAPSK (Twisted Amplitude Phase Shift Keying). The TAPSK which is a modified version of PSK where the amplitude is switched back and forth on successive constellations may provide higher coding efficiency then traditional techniques for similar error correcting capacity when configured properly for specific block size and back and forth amplitude (radius ratio). This paper presents the Impact Analysis and Comparison of Code Block Size and Radius Ratio on TAPSK Modulation for development of efficient digital communication technique under AWGN and Rayleigh Channels. Finally the simulation results are compared with traditional modulation techniques for BER and Modulation Efficiencies which shows that the TAPSK can achieve much better BER performance with a little compromise with coding efficiency.

Keywords— Twisted Amplitude Phase Shift Keying (TAPSK), Multilevel-Block Coded Modulation.

INTRODUCTION

The non-coherent detection gives a basic receiver building design on the grounds that it doesn't oblige carrier phase following henceforth it is favored for the systems where the more straightforward receiver structural planning are needed. To enhance the reliability non-coherent detection Non-coherent block codes methods for the additive white Gaussian noise (AWGN) channel were additionally proposed in [2],[5], including non-coherent block-coded MPSK (NBC-MPSK) [4],[5], differentially encoded QAM (Quadrature Amplitude Modulation) without channel coding was proposed [1]. The creators of [1] inferred a base vitality limitation for developing the base non-coherent distance between the symbols. The sign heavenly body considered for TAPSK (twisted amplitude phase shift keying) is considered with two distinct amplitudes for progressive consolations. This paper manages examination and effect of distinctive arrangement parameters of TAPSK with multilevel non-coherent block codes (NBC) for improvement of effective advanced correspondence system. In rest of paper the second section shows the brief survey about the TAPSK and multilevel non-coherent block codes (NBC). The third section shows the model of the simulated system and the simulated results and conclusion are discussed in fourth and fifth segments separately.

REMAINING CONTENTS

1. Literature Review

Another non-coherent succession detection calculation for joined demodulation and decoding of coded straight modulations transmitted over additive white Gaussian noise channels, perhaps influenced by between image impedance, are exhibited in [6]. The writing likewise proposed an ideal grouping detection in the vicinity of an arbitrary revolution of the sign phase taking into account legitimate rough guesses. This outcome a basic imperfect detection plans in light of the Viterbi calculation, whose execution approaches that of coherent detection. In the proposed plans [6], the tradeoff in the middle of unpredictability and execution is just controlled by a parameter, alluded to as verifiable phase memory, and the quantity of conditions of a trellis graph. Other than being feasible, these plans have the advantageous highlight which encourages uprooting the steady phase supposition and enveloping time-shifting phase models. Ruey-Yi Wei et al [3] propose three non-coherent block-coded twisted amplitude and phase shift keying (NBC-TAPSK) plans which are gotten from non-coherent block-coded MPSK. The creators additionally proposed another non-coherent detector and a relating non-coherent distance for non-consistent vitality motions over the additive white Gaussian noise (AWGN) channel. At high information rates, NBC-8TAPSK has the best bit error execution among all non-coherent plans. Further Results on Non-coherent Block-Coded MPSK is displayed in [5]. The paper first concentrate on the rotational invariance (RI) of NBC-MPSK. In view of the RI property of NBC-MPSK with multistage decoding, a non-coherent close ideal direct multifaceted nature multistage decoder for NBC-MPSK is proposed, they likewise examined a tree-hunt ML decoding calculation down NBC-MPSK indicated to have low many-sided quality and fabulous error execution. The creators additionally used the thought of the NBC-MPSK to outline non-coherent space-time block codes, called non-coherent space-time block-coded MPSK (NSTBC-MPSK). Various Phase Codes for Detection without Carrier Phase Reference in proposed by Feng-Wen Sun et al [4] in the paper creators consider the development and examination of direct block codes for M-exhibit Phase-Shift Keying that can be decoded without carrier phase synchronization. Under these circumstances, the capacity that has a significant effect on execution is the non-coherent distance, similarly to the Euclidean distance for the coherent case. The major difficulty in developing and breaking down such codes lies in the way that the non-coherent distance is not a genuine metric. Hence, earlier work principally depends on numerical ways to deal with quest for good codes and to focus the relating least non-coherent distance. However in this writing the writer's first present a hypothesis that connects the non-coherent distance with the Euclidean and Lee distances. This hypothesis permits to build great codes and focus their base non-coherent distances diagnosis.

2. Twisted Amplitude Phase Shift Keying (TAPSK)

According to the definition and explanation given by [3] the constellation diagram of 8PSK and 8TAPSK is shown in Fig. 1 (a)(b), where the bit in level a decides the symbol energy. The radiuses of the inner and outer circles are denoted by $r0$ and $r1$, respectively.

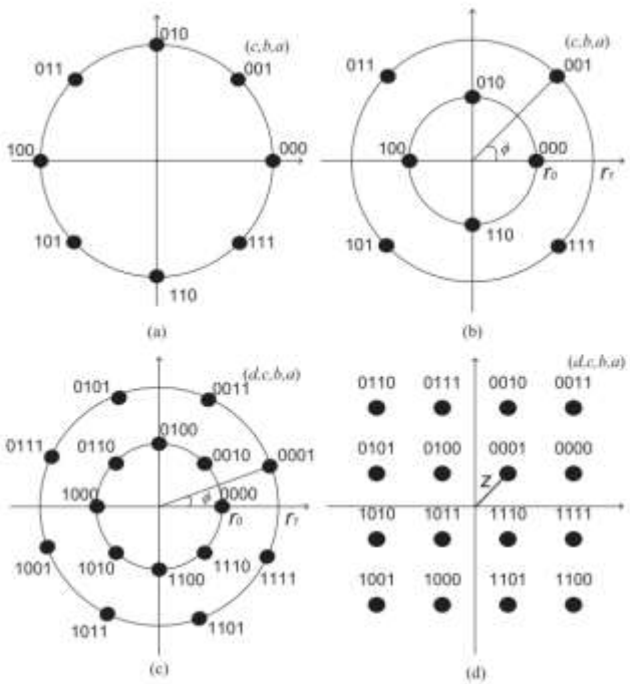

Figure 1: Constellations with bit labeling for (a) 8PSK (b) 8TAPSK ($\phi = \pi/4$)(c) 16TAPSK ($\phi = \pi/8$) (d) 16QAM.

3. Non-coherent Distance

For MPSK signals, the squared non-coherent distance between x_1 and x_2 is defined by $d_{nc}^2(x_1, x_2) = N - |(x_1, x_2)|$[2]. The minimum squared non-coherent distance of a code C, denoted by d_{nc}^2, is defined as the minimum value of $d_{nc}^2(x_1, x_2)$ between any two codewords x_1 and x_2 of C which correspond to different information bits.

Non-coherent block-coded MPSK is defined as block-coded MPSK whose component codes for coding level a, b and c $(2^0, 2^1$ and $2^2)$ are C_a, C_b and C_c, respectively. The minimum squared non-coherent distance of NBC-8PSK is

$d_{nc}^2 = min\{d_{nc,a}^2, d_{nc,b}^2, d_{nc,c}^2\}$,

Where

$$d_{nc,a}^2 = \sqrt{N - \left(N - \frac{2-\sqrt{2}}{2} d_{a,min}\right)^2 + \frac{d_{a,min}^2}{2}},$$

$$d_{nc,b}^2 = \sqrt{N - \left(N - d_{b,min}\right)^2 + d_{b,min}^2}$$

$$and\ d_{nc,c}^2 = 2d_{c,min}.$$

4. Non-coherent Block-Coded TAPSK Schemes

To increase $d_{nc,a}$ of NBC-8PSK, we propose to enlarge the energy of the symbols with $a = 1$ and reduce the energy of the symbols with $a = 0$, which becomes 8TAPSK. Hence, the bit in level a decides the power which the considered symbol should spend. Define $r = r_1 / r_0$. When $r = 1$, 8TAPSK is the same as 8PSK. For the energy normalization, the values of r_0 and r_1 $(r_0 \leq 1 \leq r_1)$ should satisfy $p_0 r_0^2 + (1 - p_0) r_1^2 = 1$ where p_0 denotes the probability of transmitting the symbols with $a = 0$ which depends on the component code C_a.

5. Multilevel Block Codes (MLBC)

For M > 2-ary digital transmission schemes like ASK, PSK, QAM or CPM (incl. FSK) an efficient combining of channel coding and modulation is possible using multilevel-coding (MLC). Transmission schemes with high power and band width efficiency can be designed by this method in various ways. MLC method is based on an iterative partitioning of the set of signal elements of the modulation scheme. The distance structure of MLC-schemes is in principle known as methods of generalized concatenated codes can be applied. Often, design of MLC-schemes is done according to the minimum Euclidean distance criterion.

A multilevel block code of L levels uses L block codes each of the same length n, called component codes, over finite alphabets of possibly different sizes. A signal set S, called the basic signal set, of dimension N, has $\prod_{i=1}^{L} m_i$ points, where m_i, $i = 1, 2, 3, \ldots, L$ are the size of the alphabets, with each point labeled by an ordered $L - tuple$ with one entry from each alphabet. With this labeling, a set of L codewords, one from each code, correspond toa point in Nn dimensions, with each coordinate of L code words choosing a point in S. Multilevel coded signal sets with linear codes over $GF(2)$ as component codes have been studied in [1]–[5] and in various general settings in [6]–[10]. Kschischang et al. [11] use linear codes over non-binary fields to construct multilevel signal sets and give algebraic structural properties of these codes. Multilevel codes for the purpose of unequal error protection have been discussed in [12] and [13]. Suboptimal multistage decoding and performance analysis of multilevel codes have been studied in [14]–[16].This correspondence deals with two-level $(L = 2)$ group codes with the basic signal set consisting of points on a circle. The block diagram of a two-level block-coded modulation is shown in Fig. 2(a).When C_s and C_r are length n

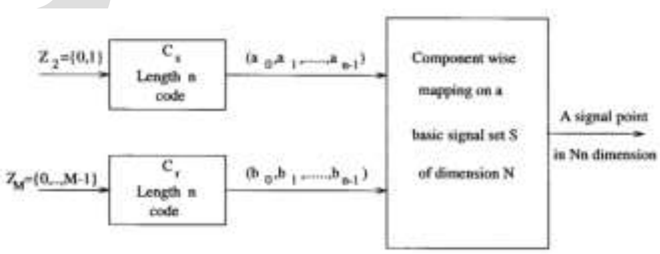

Figure 2(a): Block diagram of a two-level block-codes modulation.

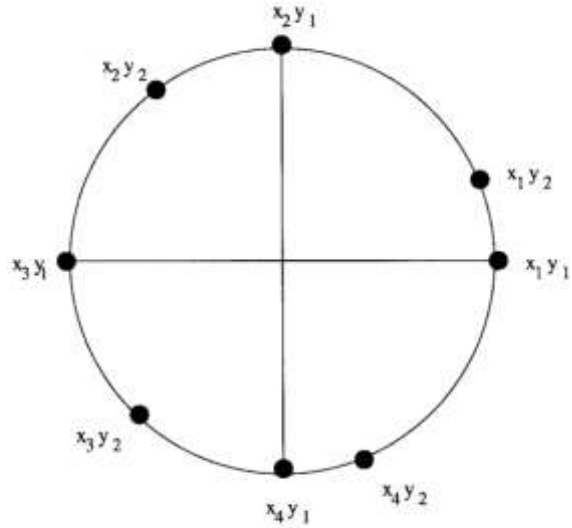

Figure 2(b): Labeling of an 8-PSK signal set with X and Y.

codes over alphabets $Y = \{y_1, y_2\}(m_1 = 2)$ *and* $X = \{x_1, x_2, x_3, x_4\}\{m_2 = 4\}$, Fig. 2(b)shows a labeling of S consisting of eight points on the circle with$X$ and Y. For code words

$$a = (a_0, a_1, \dots, a_{n-1}) \in C_s \text{ and } b = (b_0, b_1, , , , b_{n-1}) \in C_r$$

Each pair (a_i, b_i); $i = 0, 1, , , , n - 1$;selects a point in S, and the pair $(a; b)$ specify a point in $2n$ dimensions. The collection of all such points in $2n$ dimensions corresponding to all possible pairs of code words constitute the two-level block-coded modulation code (signal set) or signal space code. This correspondence concerns Y and X being Z_2 and Z_M residue class integers modulo 2 and M, respectively, and the basic signal set being a collection of $2M$ points on a unit circle matched to the dihedral group with $2M$ elements.

6. Simulation Results

The complete system is simulated under Matlab environment, with different system configurations and channel conditions. Finally the outputs are presented in graphical and tabular format.

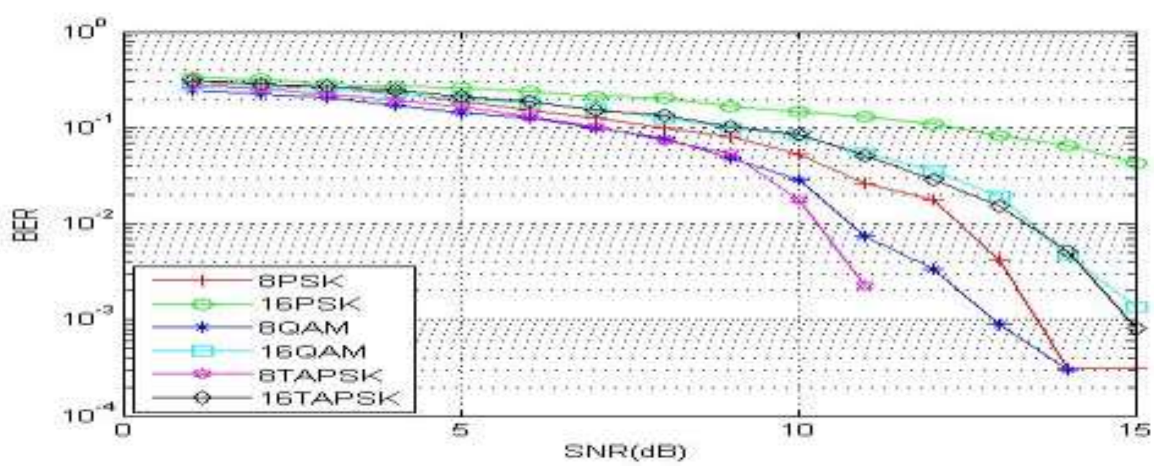

Figure 3: SNR vs. BER Comparison plot for AWGN Channel d = 4, r = 0.5, Block Length = 31.

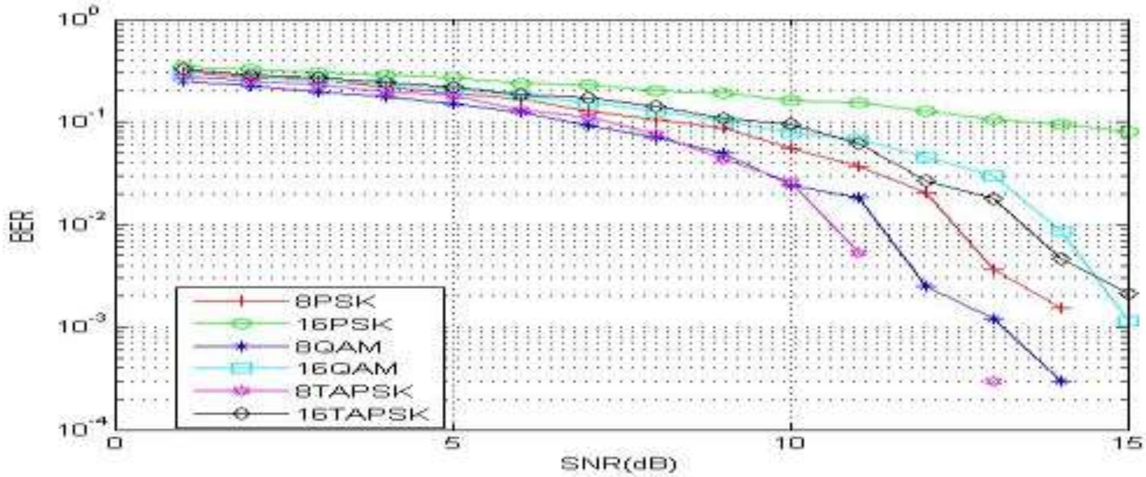

Figure 4: SNR vs. BER Comparison plot for AWGN + Rayleigh Channel d = 4, r = 0.5, Block Length = 31.

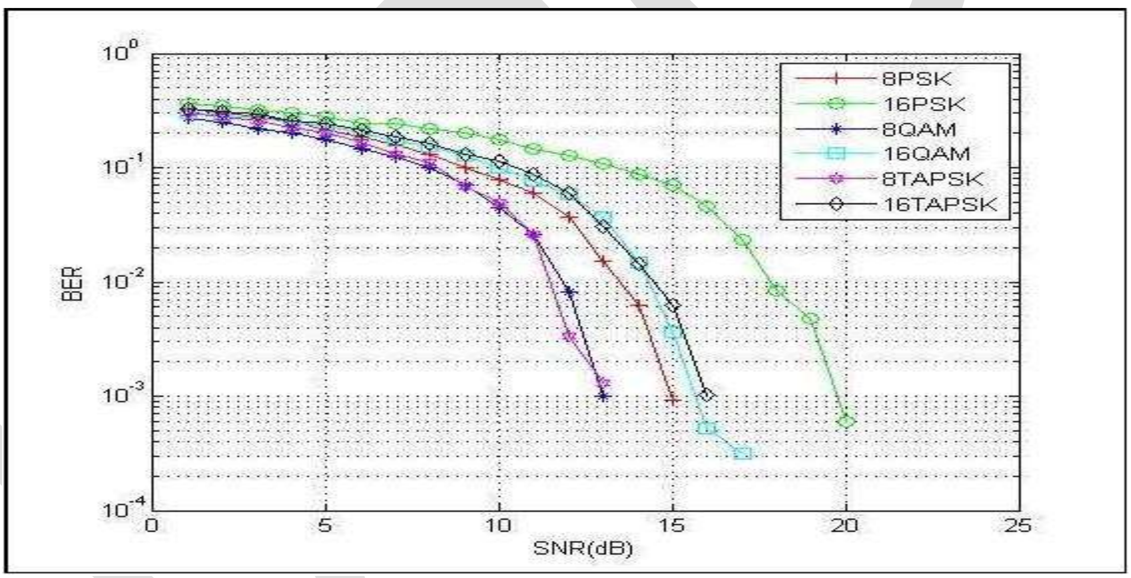

Figure 5: SNR vs. BER Comparison plot for AWGN channel d = 4, r = 0.5, Block Length = 63.

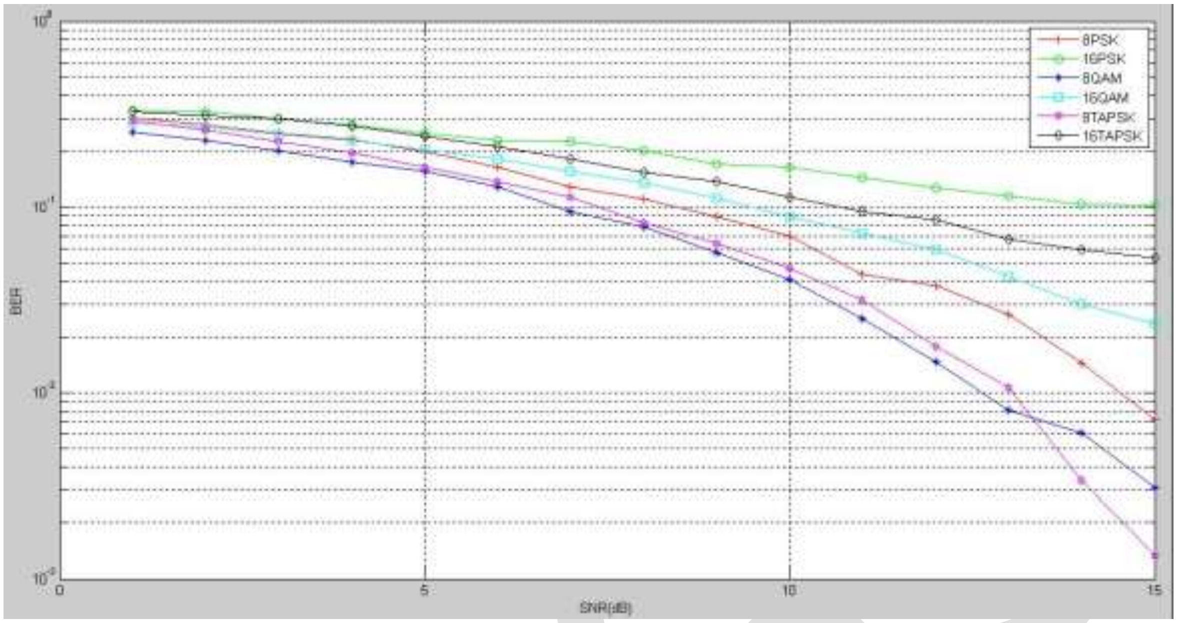

Figure 6: SNR vs. BER Comparison plot for AWGN +Rayleigh Channel d = 4, r = 0.5, Block Length = 63.

Table 1: Spectral Efficiency (bits/sym) Comparison

Block Length	8PSK	8QAM	8TAPSK
31	2.1935	1.5484	1.3871
63	2.5238	2.0952	2.0476
127	2.7244	2.4488	2.4488

Table 2: Spectral Efficiency (bits/sym) Comparison

Block Length	16PSK	16QAM	16TAPSK
31	2.4488	3.4488	2.6772
63	2.8242	3.5782	3.0589
127	3.0240	3.6411	3.2401

Table 2: 8TAPSK Spectral Efficiency Comparison for Different Values of r.

r	Spectral Efficiency
0.2	1.3465
0.4	2.3386
0.6	2.5591
0.8	2.6142

CONCLUSION

The simulation performed for the 8PSK/16PSK and 8TAPSK/16TAPSK modulation techniques with multi level NBC and AWGN and Rayleigh channel conditions for non-coherent detection, shows that the 8TAPSK/16TAPSK provides a Lower BER at small spectral cost. The result also shows that 8TAPSK/16TAPSK greatly out performs the 8PSK/16PSK and 8QAM/16QAM for Rayleigh Channels while the increased Block Length can also be used to increase the spectral efficiency. Furthermore the ratio “r” can be optimally set to get tradeoff between spectral efficiency and BER.

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