PERFORMANCE ANALYSIS OF QPSK MODULATION SCHEMES USING GRAY & NAIVE CODING WITH RAYLEIGH FADING CHANNEL

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ABSTRACT

Orthogonal Frequency Division Multiplexing (OFDM) using Quadrature Amplitude system keying is a very common approach in multi carrier communication. In this paper, we have shown a comparative analysis between the GRAY and NAÏVE QPSK scheme with OFDM in both AWGN and Rayleigh fading channel. We have chosen the parameters BER vs SNR for Gray and naïve and Rayleigh for the performance analysis as these two are the most important parameter for any wireless communications.

Keywords: OFDM, GRAY, NAÏVE, QPSK, AWGN, BER, SNR

I.INTRODUCTION

OFDM has its major benefits of higher data rates and better performance. High data rates are achieved by the use of multiple carriers and performance improvement is caused by the use of guard interval thus mitigating ISI. In many wideband cellular systems, the channel experiences frequency selective fading In this paper we present the BER analysis of QPSK-OFDM systems over Rayleigh fading channel. Our Technical contributions are summarized below .We express the average SNR in terms Vs BER with gray and naïve code and Rayleigh fading channel.

1.1 QPSK

In QPSK, the data bits to be modulated are grouped into symbols, each containing two bits, and each symbol can take on one of four possible values: 00, 01, 10, or 11. During each symbol interval, the modulator shifts the carrier to one of four possible phases corresponding to the four possible values of the input symbol. In the ideal case, the phases are each 90 degrees apart, and these phases are usually selected such that the signal constellation. This structure uses the trigonometric identity

$$I\cos\omega ct+Q\sin\omega ct=R\cos(\omega ct+\theta) \quad\quad\quad\quad (1)$$

Where $\quad\quad\quad\quad R=\sqrt{(I^2+Q^2)} \quad\quad\quad\quad (2)$

$$\theta=\tan^{-1}(Q/I) \qquad (3)$$

If the output of this modulator is to be represented in complex-envelope form referenced

to the carrier frequency, the modulated signal is given simply as

$$\tilde{x}(t)=I(t)+jQ(t) \qquad (4)$$

Simulation of this idealized signal requires only a trivial model of the modulator. The complex signal

$\tilde{x}(t)$ is formed by simply using the in phase baseband signal I(t) as the real part and the quadrature baseband signal Q(t) as the imaginary part.

1.2 GRAY CODE

The reflected binary code, also known as Gray code after Frank Gray, is a binary numeral system where two successive values differ in only one bit. The reflected binary code was originally designed to prevent spurious output from electromechanical switches. Today, Gray codes are widely used to facilitate error correction in digital communications such as digital terrestrial television and some cable TV systems.

An n-bit Gray code, also called there reflected binary code, is an ordering of the 2n strings of length n over{0,1}such that every pair of successive strings differ in exactly one position.

Instead of the usual binary representation, we see that incrementing a number by one involves flipping only one bit. In the usual binary representation, incrementing by 1 could lead to a sequence of bits that are carried over, which may change several consecutive bits at once.

1.3 NAIVE CODE

This section formally states the assumptions and notations and recalls the naive Bayes and selective naive Bayes approaches.

Assumptions and Notation:

Let $X = (X1; X2; : : : XK)$ be the vector of the K explanatory variables and Y the class variable. Let $\lambda_1; \lambda_2; : : : \lambda_J$ be the J class labels of Y.

Let N be the number of instances and $D = \{D_1; D_2; \ldots; DN\}$ the labeled database containing the

instances $Dn = (x^{(n)}; y^{(n)})$. Let $M = \{Mm\}$ be the set of all the potential selective naive Bayes models. Each model Mm is described by K parameter values a^{mk}, where a^{mk} is 1 if variable k is selected in model Mm and 0 otherwise.

Let us denote by $P(\lambda_j)$ the prior probabilities $P(Y = \lambda_j)$ of the class values, and by $P(Xk|\lambda j)$

the conditional probability distributions $P(Xk|Y = lj)$ of the explanatory variables given the class values.

We assume that the prior probabilities $P(\lambda_j)$ and the conditional probability distributions

$P(Xk|\lambda_j)$ are known, once the preprocessing is performed.

In the experimental section, the $P(\lambda_j)$ are estimated by counting and the $P(Xk/\lambda_j)$ are computed using the contingency tables, resulting from the preprocessing of the explanatory variables. The conditional probabilities are estimated using a m-estimate (*support* +mp)=(*coverage*+m) with $m = J=N$ and

$p = 1=J$, in order to avoid zero probabilities.

33 | P a g e

1.3.1 Naive Bayes Classifier

The naive Bayes classifier assigns to each instance the class value having the highest conditional probability

$$P(\lambda_j j X) = P(\lambda_j)P(Xj\lambda_j) \,/P(X) \tag{5}$$

Using the assumption that the explanatory variables are independent conditionally to the class

variable, we get

$$P(\lambda_j j X) = P(\lambda_j)\textstyle\prod K_{k=1} P(Xkj\lambda_j)/P(X) \tag{6}$$

In classification problems, Equation (6) is sufficient to predict the most probable class given the input data, since $P(X)$ is constant. In problems where a prediction score is needed, the class conditional probability can be estimated using

$$P(\lambda_j j X) = P(\lambda j)\textstyle\prod K_{k=1} P(Xkj\lambda j)/\sum J_{i=1} P(\lambda i)\prod K_{k=1} P(Xkj\lambda i) \tag{7}$$

The naive Bayes classifier is poor at predicting the true class conditional probabilities, since the independence assumption is usually violated in real data applications. However, Hand and Yu (2001) show that the prediction score given by Equation (7) often provides an effective ranking of the instances for each class value.

II. ANALOGY BETWEEN SPECTRAL BROADENING IN FADING AND SPECTRAL BROADENING IN KEYING A DIGITAL SIGNAL

Let us discuss the reason why a signal experiences spectral broadening as it propagates from, or is received by, a moving platform, and why this spectral broadening (also called the fading rate of the channel) is a function of the speed of motion. An analogy can be used to explain this phenomenon. Figure 3 shows the keying of a digital signal (such as amplitude shift keying or frequency shift keying), where a single tone cos2Π*fct* defined for $-\infty < t < \infty$ is characterized in the frequency domain in terms of impulses (at ±*fc*). This frequency domain representation is ideal (i.e., zero bandwidth), because the tone is a single frequency with infinite time duration. In practical applications, digital signaling involves switching (keying) signals on and off at a required rate. The keying operation can be viewed as multiplying the infinite-duration tone in Fig. 3a by an ideal rectangular on-off (switching) function in Fig. 3b. The frequency-domain description of this switching function is of the form sinc *fT*. In Fig. 3c, the result of the multiplication yields a tone, cos2Π *fct*, that is time-duration limited. The resulting spectrum is obtained by convolving the spectral impulses shown in part (a) of Fig. 3 with the sinc *fT* function of part (b), yielding the broadened spectrum depicted in part (c). It is further seen that if the signaling occurs at a faster rate characterized by the rectangle of shorter duration in part (d), the resulting signal spectrum in part (e) exhibits greater spectral broadening. The changing state of a fading channel is somewhat analogous to the on-off keying of digital signals. The channel behaves like a switch, turning the signal on and off. The greater the rapidity of the change in the channel state, the greater is the spectral broadening experienced by signals propagating over such a channel. The analogy is not exact because the on and off switching of signals may result in phase discontinuities, whereas the typical multipath-scattered environment induces phase-continuous effects.
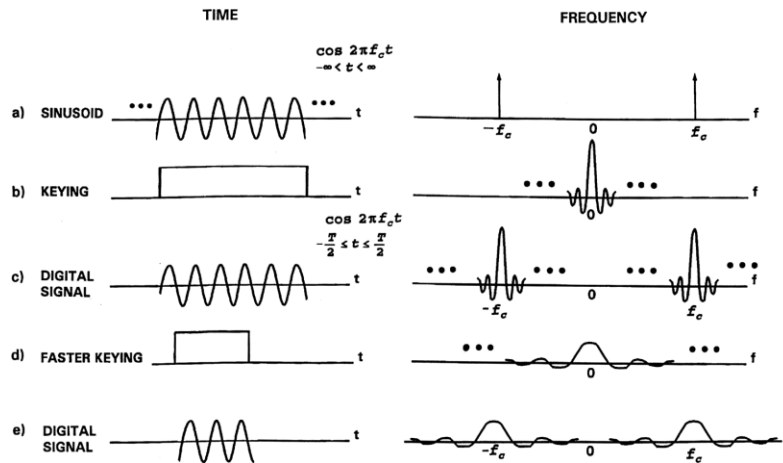
Figure1: Analogy between spectral broadening in fading and spectral broadening in keying a digital signal

III.FLOWCHART

It is clear that the amplitude has a Rayleigh distribution and that the phase has a uniform distribution when we observe the received signal at the arrival time. It is also clear that there are fixed ratios of the average electric powers of the direct and delayed waves.
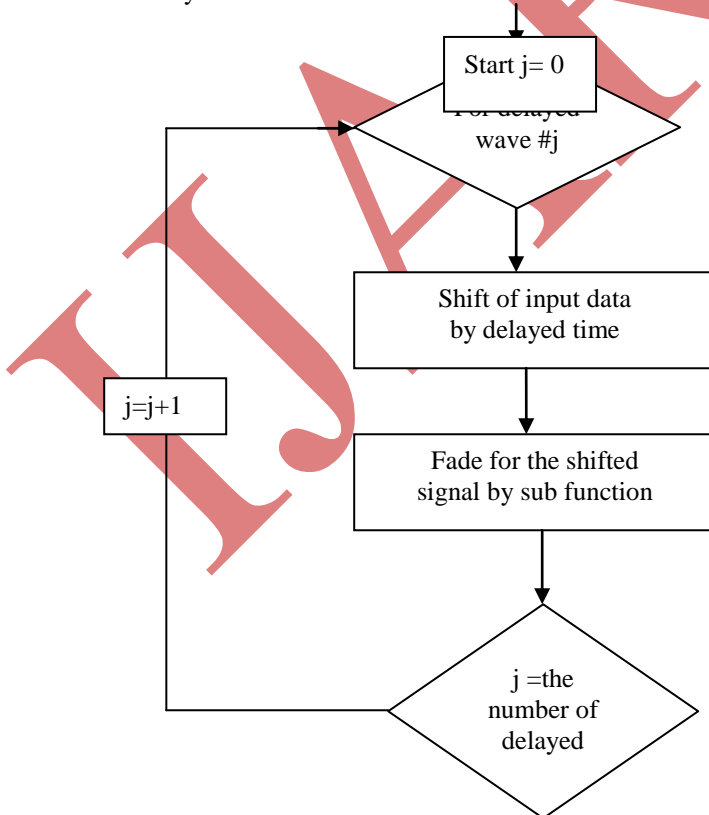
That is to say, we have only to give the relative signal level and relative delay time of delayed waves in comparison with the direct wave, when this multipath propagation environment is simulated

IV.SIMULATION RESULTS AND DISCURSSION

In figure 2 & 3 BER for QPSK compare the results with the theoretical value. Here the BER expression using the naive code [00, 01,10, 11] and compare the results with that from Gray code. In this case before set the Number of bits or symbols and Symbol Energy ,Bit Energy. After setting SNR range in dB we get BER for theoretical and simulated value.
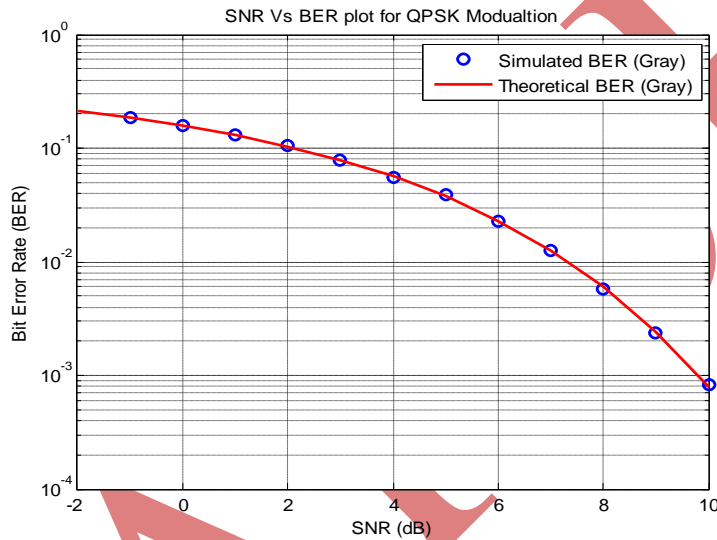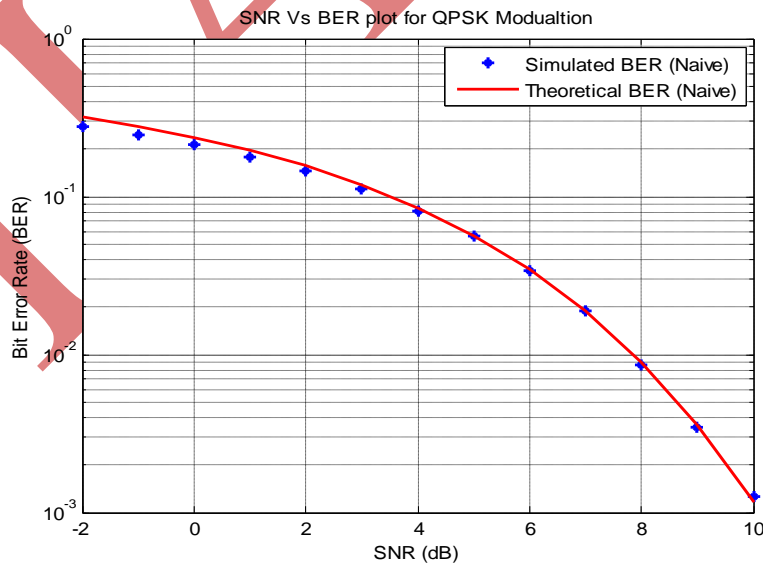

Figure 2.BER Vs SNR of gray code

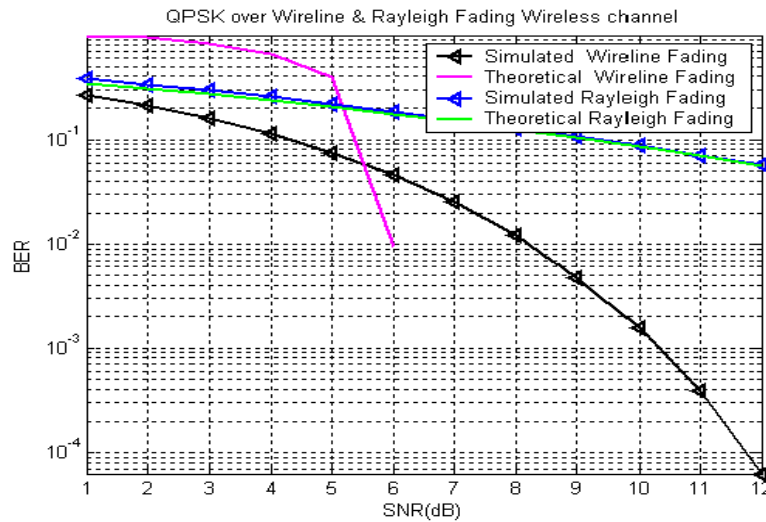**Figure 3: BER Vs SNR of Naive code**

Figure 4: BER Vs SNR of Rayleigh fading channel

In figure 4 shows QPSK simulation over Rayleigh Fading wireless channel and its comparison with QPSK transmission over Wire line channel In this case before set the Number of bits or symbols and Symbol Energy ,Bit Energy. After setting SNR range in dB we get BER for theoretical and simulated value over wire line and wireless channel in the presents of AWGN.
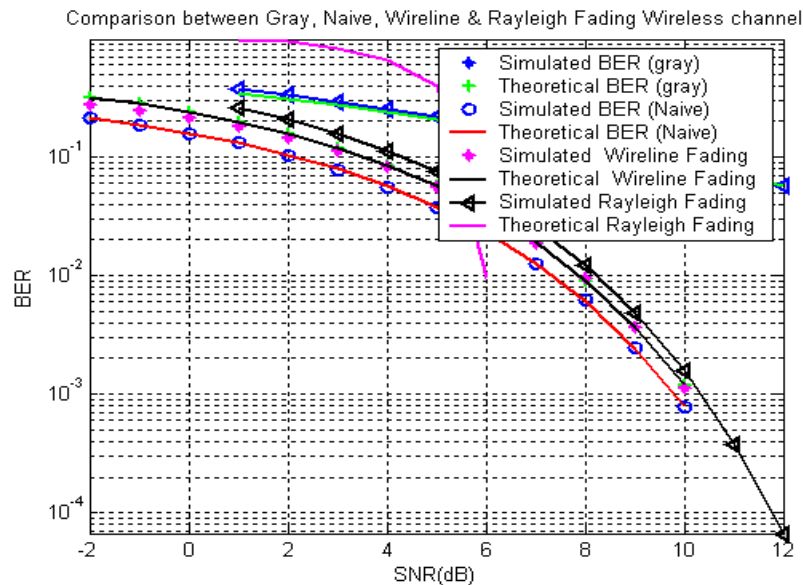

Figure 5:BER Vs SNR in GRAY, NAÏVE, Wireline & Rayleigh Fading Channel

In figure 5 shows GRAY NAÏVE AND QPSK simulation and Rayleigh Fading wireless channel
and its comparison with QPSK transmission over Wire line channel. In this case we set same the Number of bits or symbols and Symbol Energy ,Bit Energy. After setting SNR range in dB we get BER for theoretical and simulated value over wire line and wireless channel in the presents of AWGN.

V.CONCLUSION

From the simulation results the clear comparison between GRAY NAÏVE and RAYLEIGH FADING CHANNEL is shown and also the BER Vs SNR also is shown here in figure 5.Here the different theoretical BER and SNR and also simulated BER ,SNR compared as the given same no of bit, bit energy, symbol energy and also same the SNR range in db.

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