BER PERFORMANCE OF PSK BY DIFFERENT METHODS
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ABSTRACT
In this paper we compare the BER by two most popular methods for PSK and comparative both and theoretical BER with Gaussian channel or fading. We study Bit-Error Rate of Coherent M-ary PSK with Gray Code Bit Mapping and Semianalytic BER for PSK. Both are very well-known method for evaluating the BER of a digital communication System. Both technique uses according to application. In this paper we see both technique importances according to application.

INTRODUCTION
M-ary PSK
We will revise the calculation of the Bit-error probability (BEP) of M-ary phase-shift keying (PSK), we use same expression to calculate BER but we use data gray coded sequence.

Consider a general M-ary modulation,
\[ \alpha_{\text{MPSK}} = \sqrt{E_s} \{e^{j2\pi k}, e^{j4\pi k}, \ldots, e^{j2\pi(M-1)} \} \]
are used.

Let us the consider the symbol on the real axis,
\[ S_0 = \sqrt{E_s} \]
The received symbol \( y = \sqrt{E_s} + n \)
Where the additive noise \( n \) follows the Gaussian probability distribution function,

\[ p(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{-\frac{(x-\mu)^2}{2\sigma^2}} \]
with \( \mu = 0 \) and \( \sigma^2 = \frac{N_0}{2} \)

The conditional probability distribution function (PDF) of received symbol \( y \) given so was transmitted is:

\[ p\left(\frac{y}{S_0}\right) = \frac{1}{\sqrt{\pi N_0}} e^{-\frac{(x-\sqrt{E_s})^2}{N_0}} \]

Theoretical Probability of bit error for M-PSK modulation
\[ p_b = \frac{1}{k} \text{erfc} \left[ \frac{kE_b}{\sqrt{N_0}} \frac{\sin\left(\frac{\pi x}{M}\right)}{M} \right]. \]

Eb = bit energy
SEMIANALYTIC BER for PSK

Computer aided methods for determining the probability of bit error \( P_b \) or BER of a digital communication system are widely used when an accurate analytic expression for BER is not available. The most general technique for BER estimation is the Monte Carlo method. A simulation is performed by passing a known data sequence through a system model and counting the bit errors at the receiver decision device. A simple and unbiased estimator of the BER is the sample mean of the simulated BER. If \( N \) is the number of bits evaluated, then as \( N \to \infty \) the estimate will converge to the true BER. In practice, the rule of thumb that \( N \) should be on the order of \( 10/P_b \) produces a 90% confidence interval of about two on the BER estimate. Simulations of systems operating at very low error probabilities therefore require prohibitively large run times to accurately estimate BER using the Monte Carlo method. There are several techniques for accelerating the estimation of BER. The method considered here is called the semianalytic or quasianalytic method. With this method the problem is broken into two parts, the first dealing with the signal component, and the second dealing with the noise component of the decision variable at the receiver. For a known data sequence and a static channel, the demodulated and sampled signal component at the decision device is deterministic and can be evaluated by simulation.

The data sequence used in the simulation should have specific properties in order to emulate random data with equiprobable symbols. Using this noise free sequence of demodulated and detected decision variables, then if the probability density of the noise component is known, the BER can be computed. This is done by integrating the noise probability density function (pdf) centered about each of the simulated noise free decision variable points over each error event region. Each integral is then weighted by the corresponding number of bit errors and the sample mean over all the weighted integrals produces the BER. Because of the complexity of this procedure for \( M \)-ary PSK, previous references have presented only approximations.
For ideal $M$-ary PSK with known symbol probabilities and arbitrary symbol bit-mapping it is possible to compute the exact BER for the additive white Gaussian noise (AWGN) channel in an efficient way. By extending these methods to include the effects of intersymbol interference (ISI), an efficient procedure for computing semianalytic BER will be developed.

PSK CONSTELLATION WITH ISI AND AWGN

The $M$ signal waveforms for ideal $M$-ary PSK are represented as $s_m(t) = g(t)\cos(\omega_c t + \theta_m)$ $m = 0, 1, ..., M - 1$ where $g(t)$ is a pulse waveform used to shape the spectrum of the transmitted signal and $\theta_m$ is the information-bearing phase angle which takes $M$ possible values $\theta_m = (2m + 1)\pi/M$ $m = 0, 1, ..., M - 1$. If an ideal PSK signal is optimally demodulated, then using complex phasor notation, each of the complex decision variables takes one of the following $M$ values $S_m = \varepsilon e^{j\theta_m}$ $m = 0, 1, ..., M - 1$ where $\varepsilon$ is the energy of the spectrum shaping pulse and is given in terms of bit energy $E_b$ by $\varepsilon = \log_2 (M)E_b$. When distortions due to channel effects or modem imperfections are present, the received decision variables will differ from the $M$ ideal points, and their locations will be data dependent due to ISI. In this context, ISI will refer to the effects of both linear and nonlinear time invariant distortions with memory. Assuming equiprobable symbols, then in order to completely characterize the ISI of a channel with $L$ symbol periods of memory, it is sufficient to consider all possible sequences of $L$ symbols. A maximal length pseudorandom $ML$ symbol sequence will satisfy this property. For $M=2$, linear feedback shift registers can be used to generate maximal length pseudorandom bit sequences. For $M>2$, efficient methods for generating maximal length pseudorandom symbol sequences have also been proposed. With the addition of cyclic prefixes and postfixes of $L$ symbols each, a simulation using one cycle of a $ML$ length pseudorandom symbol sequence is sufficient to emulate equiprobable data symbols. Therefore, performing a simulation using $ML + 2L$ symbols from a maximal length $ML$ symbol sequence, and discarding the first and last $L$ demodulated and detected decision variable points, the resulting $ML$ decision variable points will completely
characterize the effect of the system ISI on the signal. This set of decision variables can be defined in terms of their respective magnitudes and phases or in-phase and quadrature components $s_k = r_k e^{j\theta_k} = i_k + j_q k = 0, 1...ML - 1$. When AWGN is present at the receiver input, the decision variables are $y_k = s_k + n_k k = 0, 1...ML - 1$.

RESULTS AND DISCUSSION
Gray code mapping give the good BER compare to other BER computation technique but it compute the BER slow as compare the semianalytic technique. Than we use both technique on the application Basis. A fast and accurate method for computing semianalytic BER for PSK with ISI and AWGN has been presented. Two simplifications were applied relative to directly evaluating the semianalytic BER using numerical integration. But BER is not small compare to gray code mapping technique. Than we combine both techniques merit and compute BER.
CONCLUSIONS
The main contribution of this letter is a closed-form expression for the average distance spectrum as a function of for the binary reflected Gray mapping. Since the derived expression differs from the results previously we also correct these results here. The difference between the previous results and the new results derived herein is small, and we show that the erroneous results resulted from an invalid assumption that the BER is independent of the transmitted symbols.

A fast and accurate method for computing semianalytic BER for PSK with ISI and AWGN has been presented. Two simplifications were applied relative to directly evaluating the semianalytic BER using numerical integration. First, the decision variable points were each rotated to decision region \( R_0 \), and the bit error weight matrix was appropriately transformed. Second, the process of numerically computing \( M-1 \) double integrals for each decision variable point was simplified to require only the evaluation of complementary error functions and \( M/4-1 \) single integrals. The technique is applicable to ideally demodulated and matched filter detected PSK with a static channel distortion, and produces an exact BER result when the received noise has a circularly symmetric Gaussian Gray code mapping give the good BER compare to other ber computation technique but it compute the BER slow as compare the semianalytic technique. Than we use both technique on the application Basis.

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