Performance Analysis of TWDP Fading System for different Modulations : A Review

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ABSTRACT
Wireless communication has unfolded significantly over the times. In wireless communication system, the phenomenon of fading requires careful scrutinization so as to get efficient data reception at the receiver side. Various factors are responsible for this process namely, multipath propagation and shadowing. This case leads to instability or swings in the received signal and hence limits the performance of contemporary world's most crucial method of data transmittal. This deviation can be either in the signal amplitude, phase or degree at which signal; is entering the receiving antenna. Performance analysis of wireless communication deals with complicated and cumbersome task but a necessary one. Various fading models have been devised in order to interpret the attributes of the channel. TWDP (Two Wave Diffused Power) fading model is the general one that can be used to frame other fading models such as Rayleigh, Rician, etc. This model is much advantageous in studying the real world scenario. TWDP fading comprises of two multipath components with presence of propagating waves. In this paper the main focus will be on performance evaluation of BPSK and DPSK schemes in TWDP fading environment. Available PDF expression in the form of Bessel function, fading parameters and order of approximation is used to check the SNR at the output of the receiver. This articulation is further used in order to study various parameters followed by the comparison between the two modulation techniques.

Keywords
TWDP fading, PDF, SNR

1. INTRODUCTION
Wireless communication is briskly blooming technology that intent to deliver information between the source and destination. The signal strength and hence performance deteriorates because of many arbitrary phenomenon such as, noise, co-channel interference, multipath fading and shadowing etc. The design goal of any communication system is to make the received power adequate by overcoming the limitations of the link. For this purpose, several fading models have been devised such as Rayleigh, Rician, Nakagami, and TWDP. Out of these, TWDP is latest one being used. Multipath fading results in reception of transmitted signal through different propagation paths that may end up constructively or destructively. In Two Wave Diffuse Power fading model, the received signal consists of two LOS components in addition to various non-specular signal components. Moreover, TWDP fading model is capable of modelling many real world wireless channels.

The notion of diversity receivers in various fading channels is of appeal for a very long time. Diversity is mainly used as a potential technique to combat the drawbacks of fading, interference and many more. Here, the multiple replicas of same information carrying received signal are combined in a specific manner. The most common diversity techniques employed in digital communication system are selection combining (SC), maximal ratio combining (MRC) and equal gain combining (EGC). Virtually all the applications, the diversity decisions are made by the receiver and are unknown to the transmitter. Selection Combining is simplest of all techniques and can be easily implemented. The algorithm for selective diversity combining is based on the principle of choosing the signal of maximum strength from all of the signals received via numerous paths, at the receiver end.[1]

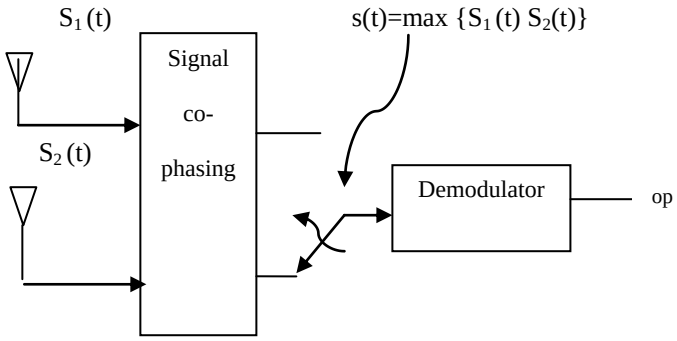


Fig.1- Selective Combining

In MRC, all the branches are selected together unlike SC. Each of the branch signals is weighted with a gain factor that is in accordance with its own SNR. Then co-phasing and summing is done for adding up the weighted branch signals in phase.EGC is also a co-phase combining that brings all phases to a common point and combines them. The combined signal is the totality of the momentary fading envelopes of the individual branches. Here the gain of every branch is considered as 1. [1]

The concept of modulation was originally instigated and is still governing as a method of delivering the information signal over the air. Electromagnetic waves propagate across the air if their frequency is very high. Therefore, to send the signal over air as wireless channel, the conversion into high frequency that will pass through the air without substantial losses is essential. This is what modulation precisely do.[7] The information signal modulates high frequency signal called carrier that travels through the air. In this paper, two of the general modulation techniques, i.e. BPSK and DPSK are employed and then compared for their performance. The bpsk modulation technique is an elementary and most resilient of all psk modulation techniques since it can handle the highest level of noise or distortion that could lead the demodulator to reach an incorrect decision. On the flip side, it is only able to modulate at 1 bit/symbol and so cannot be applied for high data-rate applications. BPSK is a modulation technique in

which the phase of the carrier signal is modified in accordance with the modulating signal. In BPSK modulation, the binary sequence is multiplied with the sine wave obtained from the oscillator to get the BPSK modulated signal. At the receiver side, the bpsk modulated signal is multiplied with the same sine wave generated by the carrier recovery circuit and passed through the integrator and the decision device to obtain the original modulated signal again.[2]

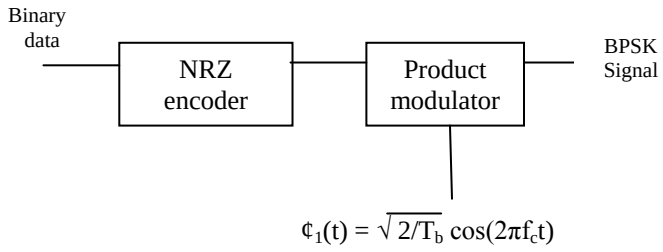


Fig.2- BPSK modulator

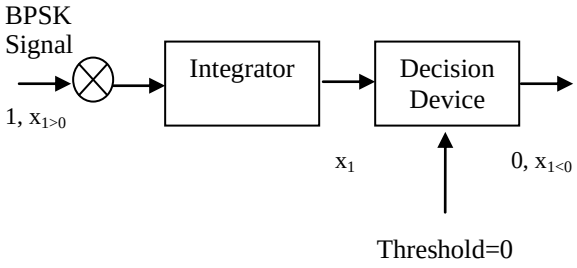


Fig.3- BPSK demodulator

DPSK is abbreviated for Differential Phase Shift Keying. It is the genre of BPSK. In this system, the change in phase of received signal rather than the phase w.r.t. the reference signal is determined. If we know the past behaviour of a signal up to some extent, we can use this prediction to make an estimate of the future value of the signal. This provides impetus for differential quantisation scheme. Here, the serial binary data passes through X-NOR gate and output is again introduced by 1 bit delay and the resulting bit stream is fed to the balanced modulator to produce DPSK signal.

For DPSK demodulator, DPSK signal is sent to the balanced modulator and 1 bit delay circuit. The resulting signal is passed through LPF which generates binary data.

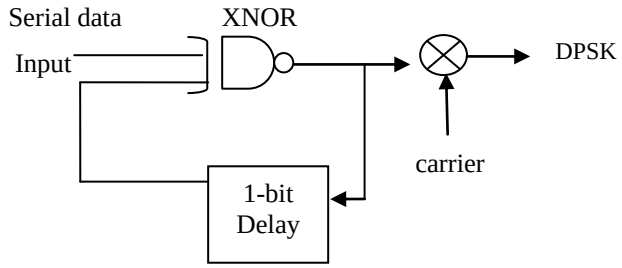


Fig. 4-DPSK modulator

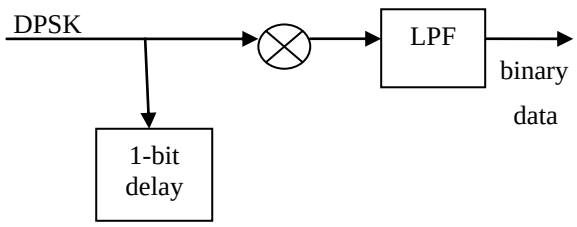


Fig. 5- DPSK demodulator

2. CHANNELS AND SYSTEMS

The channel is supposed to be frequency selective with TWDP fading characteristics. The received signal over one symbol duration T_s is expressed as

$$\mathbf{R'(t) = re^{j¢}s(t)+ n(t),}$$

Where s(t) is the transmitted symbol of energy E_b and n(t) is the noise. The random variable (¢) signifies phase and r is the TWDP fading amplitude.[3]

Analysis of TWDP fading systems requires the TWDP fading PDF. The PDF expression is an infinite series which can be evaluated using basic mathematical operations i.e. summation and multiplication. This expression makes fast and accurate evaluation of the TWDP fading PDF possible, over the practical range of TWDP fading characteristics. The overall PDF is given as:-

$$\mathbf{PDF_R(r) =(r/\sigma^2) \exp (- K - r^2/ 2\sigma^2) \sum a_i D(r/\sigma ; K ; a_i)}$$

$$\mathbf{where\ D(z;K;a_i) = (1/2) \exp (a_i K)I_o(z\ \ 2K\sqrt{(1-a_i)}\ ) +}$$

$$\mathbf{(1/2) \exp (-a_i K) I_o (z\ \ 2K\sqrt{(1-a_i)}\ ) ,}$$

$\mathbf{a_i=}$ $\mathbf{\triangle os\ (\pi\ (i-1)\ /\ (2L-1)),}$ I_o is the Bessel function of first kind and zeroth order, K is the ratio of total specular power,

$\triangle$ indicates the relative strength of the two line of sight components, L is the order of TWDP PDF and is given as

$\mathbf{L \geq (1/2) K \triangle}$ [6].

In SC receiver, the SNR of received signals from all the branches are monitored and the branches having highest SNR are selected for detection. Mathematically, output SNR is given as

$$\gamma_{SC}=\text{Max}\ (\gamma_1, \gamma_2 ... \gamma_M)$$

where γ_t is the instantaneous branch SNR of the SC receiver.[5]

3. PARAMETERS ANALYSED

In addition to TWDP PDF, two more parameters are taken into consideration which are outage probability and average bit error rate.

A. Outage Probability

Outage probability can be explained as the probability that the error at any particular instant will increase a pre-defined threshold or no. Whenever the threshold is crossed the value is incremented by one. [4]

B. Average bit error rate (ABER)

An expression for the ABER can be obtained by dividing the total error by number of bits for the modulation scheme employed.[4]

ABER=Total error/N

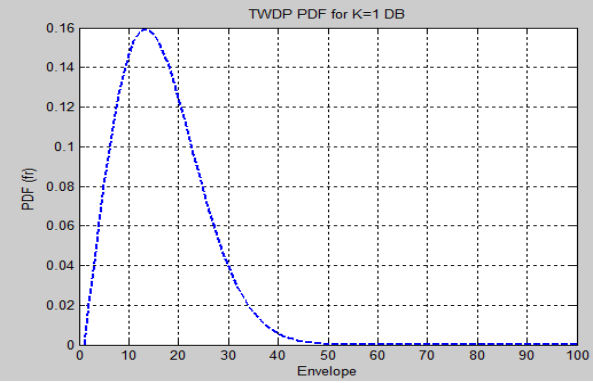
4. PROBLEM FORMULATION

Efficiency investigation of digital wireless communications systems usually deals with complicated and cumbersome statistical tasks. When the signal is to be transmitted over number of antennas, the channels are set to transmit and receive the signals having different delay, phase and amplitude. The fading in the signal is caused due to the

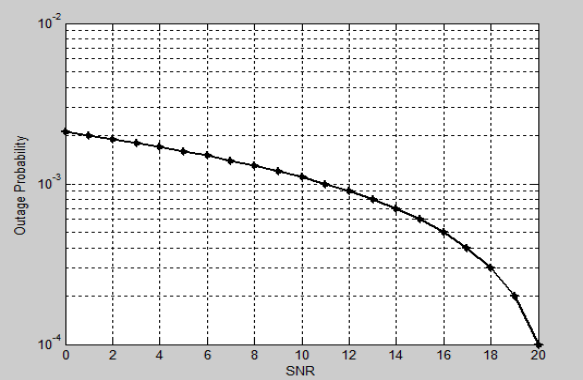
fluctuations in the signal strength. . The noise is added to the signal during the propagation. The noise added can reduce the quality if the received signal. As the signal that is to be received should be same as it is sent .so that the information is received properly. Modulation techniques were firstly proposed. But out of these which is better is the base of this paper.

TWDP fading is the latest fading channel and not much work has been done. Hence is chosen for consideration. It is a generalized technique that can be used to formulate other fading models also. In addition to this, An SC diversity technique is proposed that could reduce fluctuations further in the signal and also the amount of noise in the signal should be reduced so that an efficient and noise free signal could be received at the receiver end. Also the efficiency of the system is to be increased.

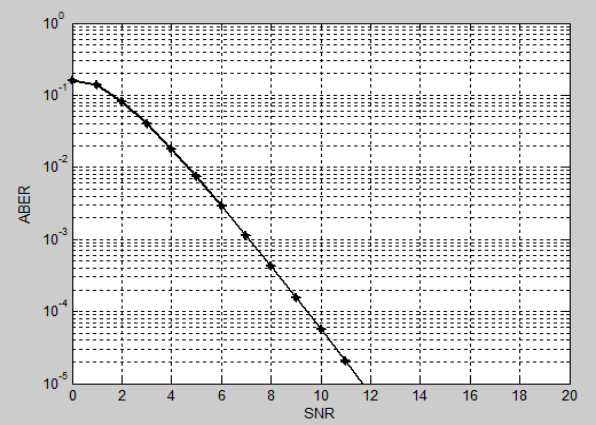
5. EXPERIMENTAL RESULTS



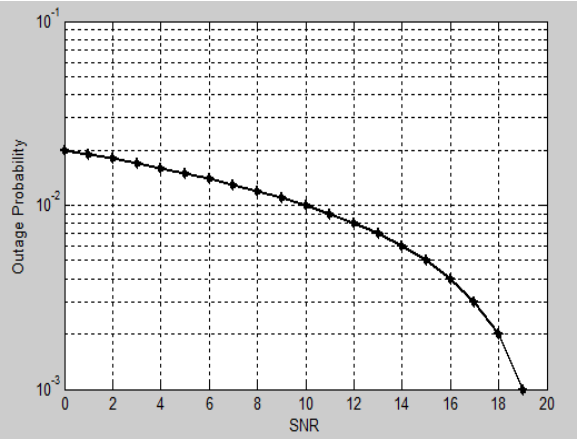
Plot 1-PDF for TWDP fading channel



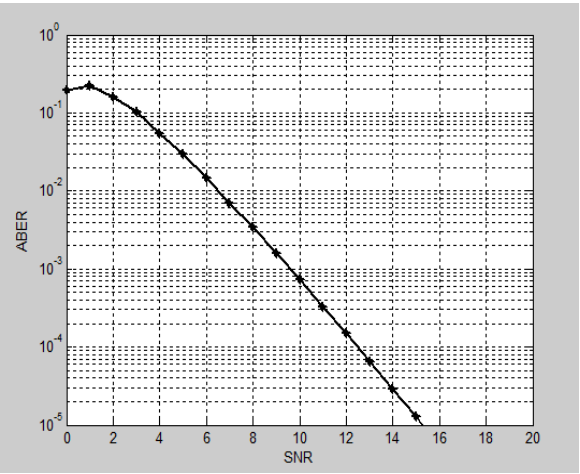
Plot 2- Outage probability for bpsk modulation



Plot 3-ABER for BPSK modulation



Plot 4-Outage probability for DPSK modulation



Plot 5-ABER for DPSK modulation

6. CONCLUSION

This paper reveals different parameters like, the performance of SC receiver with BPSK and DPSK modulation over TWDP fading channel is analysed and results are obtained using MATLAB software. The parameters taken into consideration are PDF, ABER and outage probability. The numerical formulas already available are used. These parameters of interest are opted for the purpose of illustration. The option for selection combiner as diversity technique that maximizes the output SNR in the presence of co-channel interference and noise is investigated. Further, probe includes plot of ABER and outage probability Vs SNR. The quality of service provided by wireless communication system can be greatly enhanced with the help of optimum selection of modulation scheme. Thus, increased wireless coverage and decremented power consumption can be hence obtained. Techniques that involve lesser complexity in the modulation and demodulation system design and prove economical are BPSK and DPSK modulation schemes.

7. ACKNOWLEDGEMENT

The authors are very much thankful to the potential reviewers for their critical work and help to improve the quality of this manuscript.

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