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BER ANALYSIS OF MULTI HOP RELAY NETWORK IN RAYLEIGH FADING CHANNEL

Astha Singh Kushwaha[1], Ankit Dalela[2]

[1]*M.Tech, Department of Electronics and Communication Engineering, School of Engineering, BBDU, Lucknow, India*
[2]*M.Tech, Department of Electronics and Communication Engineering, School of Engineering, BBDU, Lucknow, India*

Abstract:- In *this paper we present the performance analysis of Probability Density Function (PDF) technique. And the comparison of two combining schemes- Maximal ration combining (MRC) and Selection Combining (SC) techniques of BER. In this contribution all the study is based on MATLAB environment when communication over Rayleigh fading channels. A simple BPSK modulation is considered.*

Keywords: *- Rayleigh Fading channel, Probability Density Function (PDF), Diversity Schemes*

1. Introduction- Multi Hop Communication and Relaying: In wireless communication system the most important factor is the mobile radio channels itself through which information travels to reach the destination. Because mobile radio channels are of random nature so they cannot be analyzed with the ease that wired channels offer. The transmission path between the transmitter and receiver keeps on charging with the time and so sometimes it may be simple line-of-sight path and sometimes it may find some obstacles in its way such as high rise buildings, mountains, trees and other scatterers. Even speed of the obstacles and scatterers have strong impacts on how rapidly and deeply the signal level fades as mobile terminal moves in the space.

Cooperative communication is one of the fastest growing areas of research, and it is likely to be a key enabling technology for efficient spectrum use in future. 1 The key idea in user-cooperation is that of resource-sharing among multiple nodes in a network. The reason behind the exploration of user-cooperation is that willingness to share power and computation with neighboring nodes can lead to savings of overall network resources. Mesh networks provide an enormous application space for user-cooperation strategies to be implemented.

The first idea involves decoding of the source transmission at the relay. The relay then retransmits the decoded signal after possibly compressing or adding redundancy. This strategy is known as the decode-and-forward protocol, named after the fact that the relay can and does decode the source transmission.

The second idea, sometimes called observation, is important when the source-relay and the source-destination channels are comparable, and the relay destination link is good. In this situation, the relay may not be able to decode the source signal, but nonetheless it has an independent observation of the source signal that can aid in decoding at the destination. Therefore, the relay sends an estimate of the source transmission to the destination. This strategy is known as the estimate-and-forward. The third idea, known as facilitation, is mostly of theoretical interest. When the relay is not able to contribute any new information to the destination, then it simply tries to stay out of the way by transmitting the signal that would be least harmful to source-destination communication.

2. SYSTEM MODEL:-

In system model there is a one direct source which is transmitter to receiver and one another is relay source which is between transmitter to Y1, then Y1 to Y2, then Y2 to Y3, and more on then Yn to receiver.

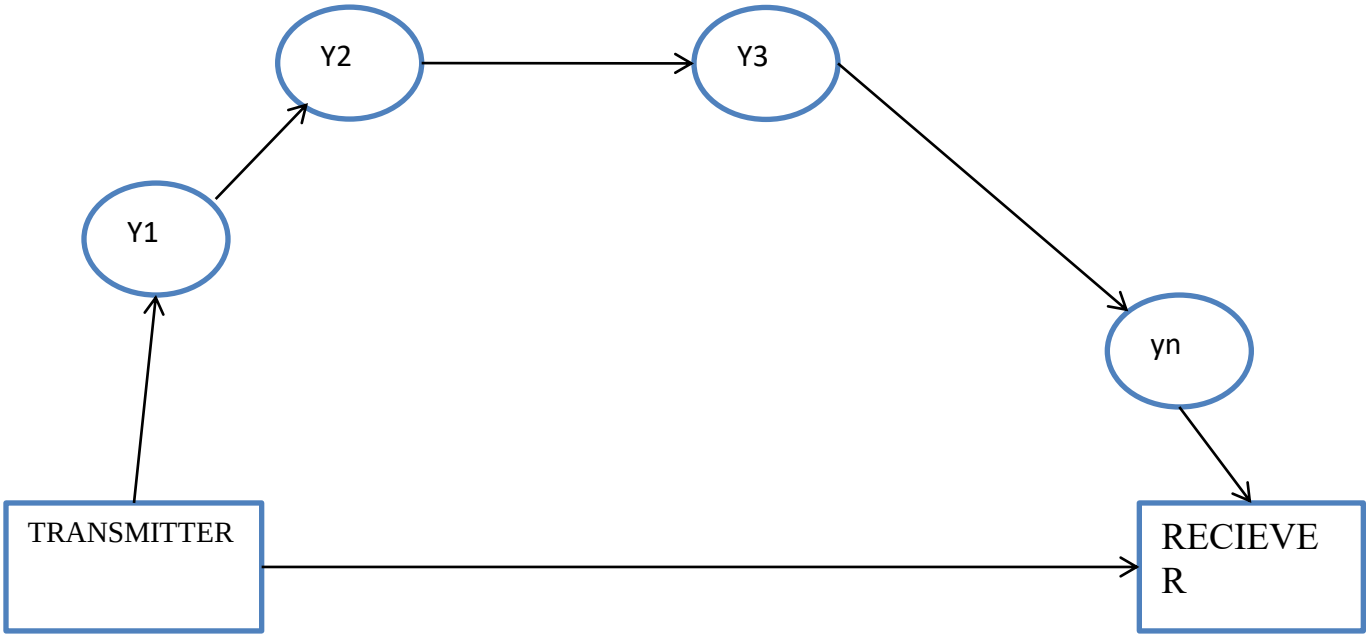

Fig.1- SYSTEM MODEL.

3. PDF ANALYSIS: In the post on Rayleigh channel model, we stated that a circularly symmetric random variable is of the form $Z = X + jY$, where real and imaginary parts are zero mean independent and identically distributed Gaussian random variables. The magnitude

$$|Z|$$

which has the **probability density**,

$$p(z) = \frac{z}{\sigma^2} e^{\frac{-z^2}{2\sigma^2}}, z \geq 0$$

is called a **Rayleigh random variable**. Further, the phase

$$\theta$$

is uniformly distributed from

$$[0, 2\pi]$$

we will try to derive the expression for **probability density function (PDF)** for $|Z|$ and θ.

Joint Probability

The probability density function of x is,

$$p(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-x^2}{2\sigma^2}}$$

Similarly probability density function of y is ,

$$p(y) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-y^2}{2\sigma^2}}$$

As X and Y are independent random variable, the joint probability is the product of the individual probability, i.e.,

$$p(x, y) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-(x^2+y^2)}{2\sigma^2}}$$

The joint probability that the random variable X lies between x and $x+dx$ and the random variable Y lies between y and $y+dy$ is,

$$P(x \le X + dx, y \le Y + dy) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-(x^2+y^2)}{2\sigma^2}} dxdy$$

Conversion to polar co-ordinate

Given that, (x, y)

Is in the Cartesian co-ordinate form, we can convert that into the polar co-ordinate

(z, θ)

Where,

$$Z = \sqrt{X^2 + Y^2}$$

And,

$$\Theta = \tan^{-1}\left(\frac{Y}{X}\right)$$

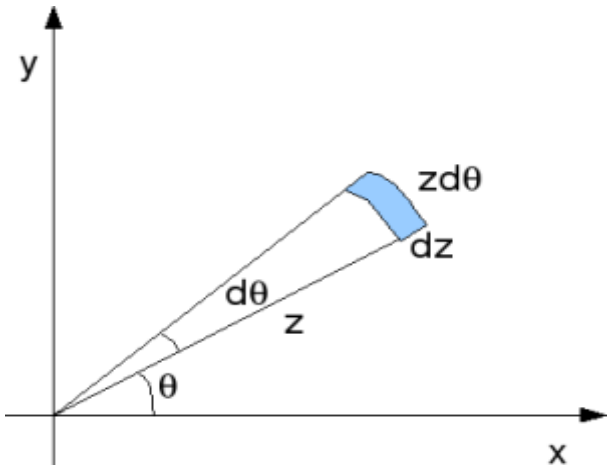

Fig.2-Cartesian co-ordinate to polar co-ordinate

The area, $dxdy$

is Cartesian co-ordinate form is equal to the area

$zdzd\theta$

in the polar co-ordinate form.

$$P(x \le X + dx, y \le Y + dy) = P(z \le Z + dz, \theta \le \Theta + d\theta)$$

Simplifying, $P(z \le Z + dz, \theta \le \Theta + d\theta) = \frac{1}{2\pi\sigma^2} e^{\frac{-(x^2+y^2)}{2\sigma^2}} zdzd\theta$

$$= \frac{z}{\sigma^2} e^{\frac{-z^2}{2\sigma^2}} dz \frac{1}{2\pi} d\theta$$

Summarizing the joint probability density function,

$$p(z, \theta) = \frac{z}{2\pi\sigma^2} e^{\frac{-z^2}{2\sigma^2}}$$

Since z

And θ

are independent, the individual probability density functions are,

$$p(z) = \frac{z}{\sigma^2} e^{\frac{-z^2}{2\sigma^2}}, z \ge 0$$

$$p(\theta) = \frac{1}{2\pi}, -\pi \le \theta \le \pi$$

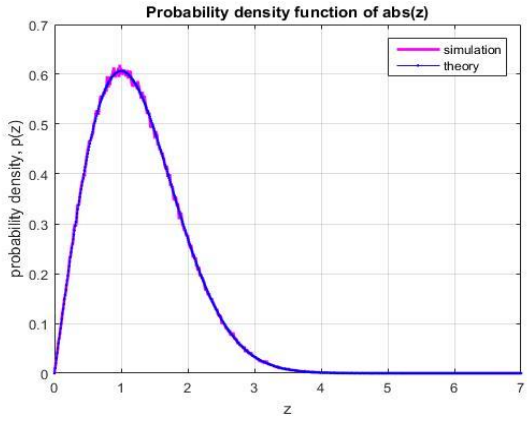

Fig.3- Probability Density Function (PDF) of Rayleigh variable

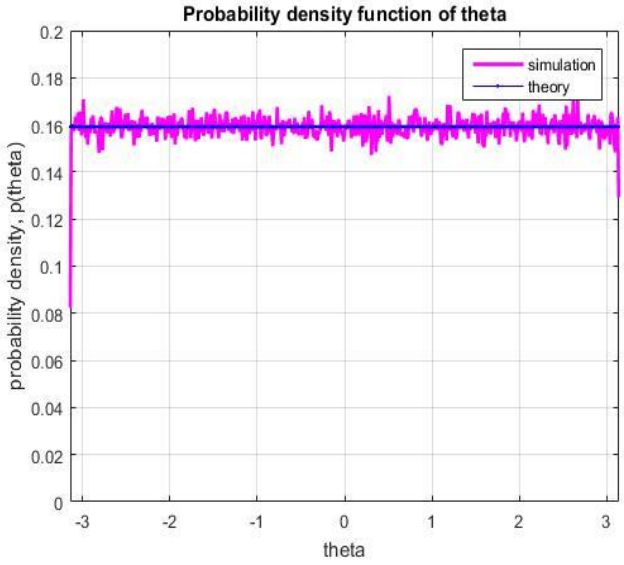

Fig.4- Probability Density Function of phase of a Rayleigh Variable

4. COMPARISON OF MRC AND SC TECHNIQUE OF BER: Maximal ratio combining (MRC) is a method of diversity combining. The signals of each channel are added together. In Maximal Ratio Combining each signal branch is multiplied by a weight factor that is proportional to the signal amplitude. That is, branches with strong signal are further amplified, while weak signals are attenuated.

Selection diversity combining technique is simplest of all other combining schemes. It is based on probability that received signal is greater than threshold. Signal with highest signal to noise ratio of all the branches is selected by the ideal selection combiner, so that output SNR is highest of incoming signal and make it available to receiver at any time.

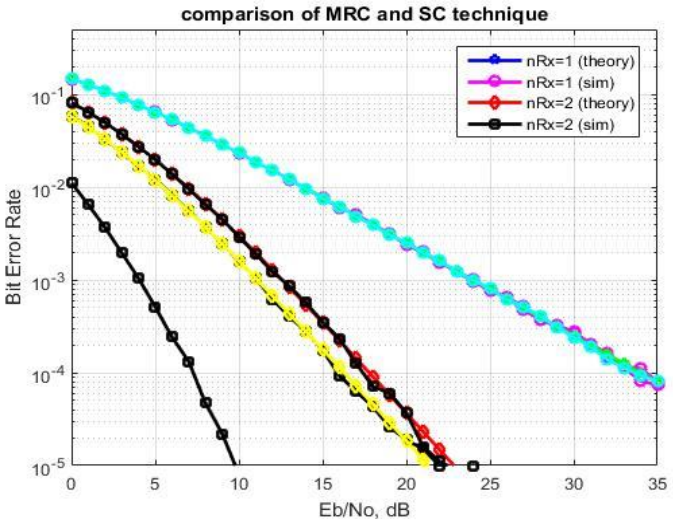

Fig.5- Comparison of MRC and SC Technique

CONCLUSION: In this paper we have generated random variables having Rayleigh fading channel of PDF. And then we have to comparison of the two different combining schemes of BER. And the phase of PDF is also presented. Analysis for different values is presented. We found that MRC gives minimum values of BER. And SC gives maximum values of BER. All the result are evaluated with the help of monte carlo simulations in MATLAB environment. It is expected that the work presented in the paper will be helpful for diversity schemes in communication systems for obtaining the higher data rates.

REFERENCES

[1] Stuber, "Principle of Mobile Communication",pp.275.

[2] Shivani Gupta and Dr. Himanshu Katiyar, "Performance Analysis of Average Received SNR of Different Combining Schemes in Presence of Imperfect Channel State Information at Receiver", COTII-2013,AIMT, Lucknow.

[3] Andrew Sendonaris, ElzsErkip and BehnaamAazhang, "User cooperation diversity part 1: System Description," IEEE Transaction on communication, vol. 51 (2003), pp 1927-1938.

[4] Andrew Sendonaris, ElzsErkip and BehnaamAazhang, "User cooperation diversity part 2: Implementation Aspects and Performance Analysis," IEEE Transaction on communication, vol. 51 (2003), pp 1939-1948.

[5] T. S. Rappaport, Wireless Communication, Chs. 3 and 4, Upper Saddle River, NJ: Prantice Hall, 1996.

[6] D.Brennan, "Linear diversity combining techniques", Proc. IRE, vol.47, pp.1075-1102, june 1959.

[7] Ning Kong, and Laurence B. Milstein, "Average SNR of Generalised Diversity Selection Combining Schemes", IEEE Communication Letters, vol.3, no.3, March 1999.

