COMPARATIVE STUDY OF DIVERSITY TECHNIQUES FOR FADING MITIGATION

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ABSTRACT

In today's world of wireless communication it is required that the signal that we transmit should have a good quality and high data rate and should be free from any kind of impairment. But there are various factors that degrade the performance of the wireless system. Fading is one of the main problems that arise in wireless communication. Hence it is very important to mitigate the fading effects so that a signal can be transmitted successfully. In this paper two diversity combining techniques, Maximal Ratio Combining and Equal Gain Combininghave been proposed to mitigate fading effects and a comparison is made between them in Rayleigh channel.

Index Terms *- Diversity, Equal gain combining, Fading, Maximal ratio combining,Rayleigh channel.*

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1. INTRODUCTION

The purpose of any communication system is to reliably transfer information between source and destination. In wireless communication the signal experiences various fluctuations and attenuation, hence the quality of the signal degrades. Fading is one of the major problems that occur in wireless communications. In between transmitter and receiver there are multiple paths through which a signal can propagate, thus the signal following different paths undergo different attenuation , distortion and phase shift. This phenomenon is called fading. Hence it is very important to mitigate the effects of fading for better performance of the system. There are various methods for mitigating fading, and diversity is one of them. In diversity several copies of the same signal is transmitted to the receiver. At the receiver these signals received over different diversity branches are combined to combat effects of fading. Diversity combining is an efficient technique to mitigate fading as it improves the overall signal to noise ratio.

2. DIVERSITY TECHNIQUES

Diversity techniques are used to remove the impairments in a signal caused by fading. There are various types of diversity techniques. Some of them are:

2.1 Antenna Diversity

In this technique a number of antennas are used, and the receiver selects the signal that will have the highest power. This is possible as the various antennas used will transmit copies of the same signal to the receiver side. And these same signal copies will undergo different interference and hence level of degradation would not be the same, due to this the signal power for each signal will vary differently.

On the receiver side that signal will be selected whose signal power is better than other signals, thus reducing the level of fading.

2.2 Time Diversity

In this technique time is taken into main consideration. Here a number of copies of thesame signal are transmitted at different time intervals.

2.3 Frequency diversity

In this technique the signal is transmitted using different frequency bands .The frequency bands carrying the signals are separated from one another using coherence bandwidth.

2.4 Polarization Diversity

In this technique those antennas are used that have different polarization. Basically in polarization diversity,a single antenna with dual polarization is used and the polarizations of that antenna are orthogonal to each other.

3.DIVERSITYCOMBINING TECHNIQUES

3.1 Maximal Ratio Combining

In MRC, we assign weighted bits to the signal, so that all the signals are strong.The branches with strong signals will be amplified further and those which are weak will be attenuated. Then the signals are finally combined to get the resultant output. Therefore MRC linearly combines the individually received branch signals so as to maximize the instantaneous output signal to- noise ratio (SNR).

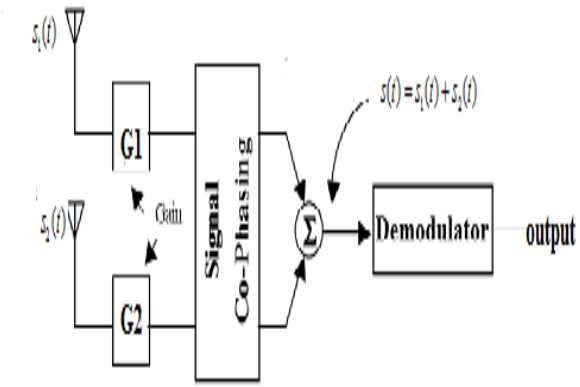

Fig-1:Block diagram of Maximal Ratio Combining

The output of MRC is given by:

$$y(t) = \sum_{i=0}^{M-1} w_i r_i(t)$$

The received SNR is:

$$\Gamma = \frac{\sum_{i=0}^{M-1} A_i^2 E_B}{N_o} = \sum_{i=0}^{M-1} \Gamma_i$$

3.2 Equal Gain Combining

In Equal Gain Combining the signal of each branch is weighted with the same factor, regardless of the signal amplitude. However, all the signals are required to be co-phased to avoid signal cancellation. In thistechnique estimation of the amplitude of thechannel is not required.

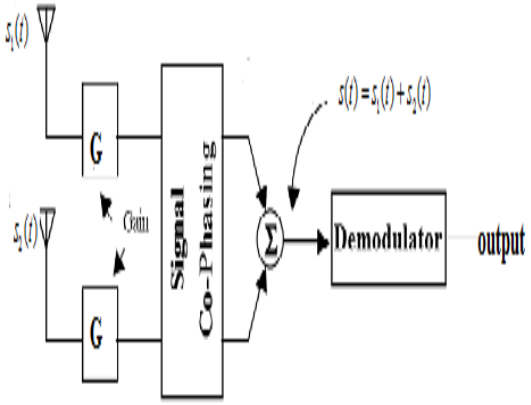

Fig-2: Block diagram of Equal Gain Combining

The output of EGC is given by:

$$y(t) = \sum_{i=1}^{M} e^{-j\theta_i} r_i(t)$$

$$= \left(\sum_{i=0}^{M} A_i\right) s(t) + \sum_{i=0}^{M} e^{-j\theta_i} Z_i(t)$$

The received SNR is:

$$\Gamma = \left(\sum_{i=0}^{M-1} A_i\right)^2 \frac{Eb}{MNo}$$

4. SIMULATION RESULTS

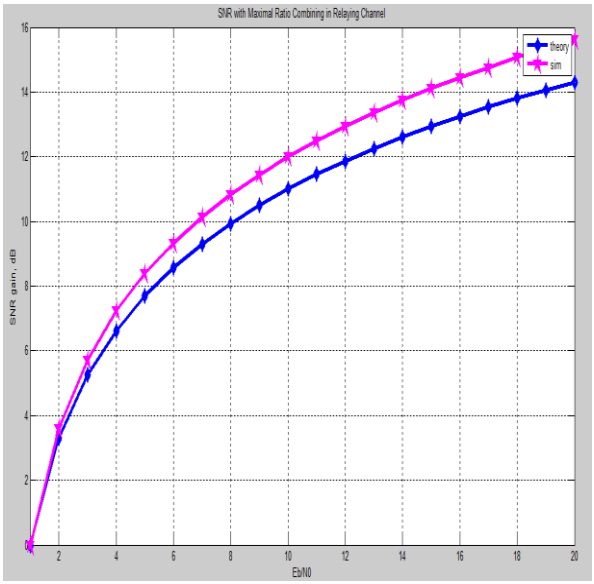

Fig-3: Simulation results of Maximal Ratio Combining in Rayleigh channel.

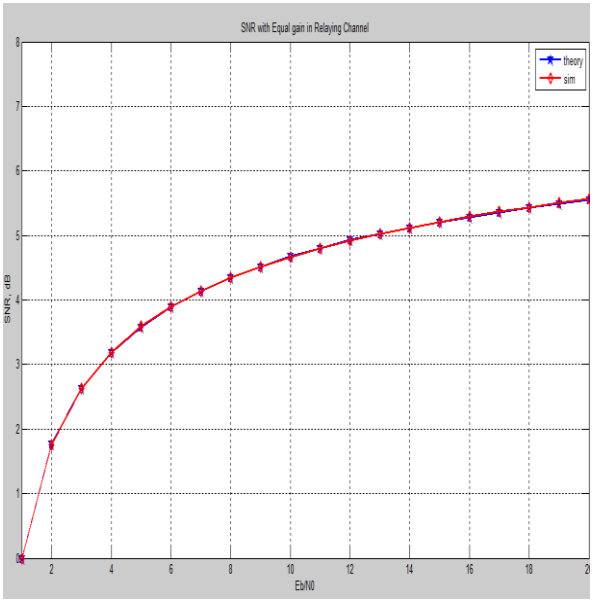

Fig- 4: Simulation results of Equal Gain Combining in Rayleigh channel.

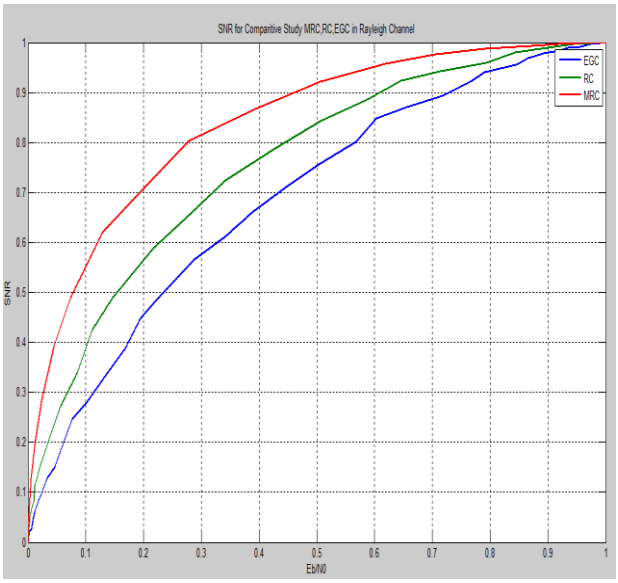

Fig-5: Comparison between Maximal Ratio Combining and Equal Gain Combining in Rayleigh channel.

5. CONCLUSION

The diversity combining technique is one of the most important methods to mitigate fading. It is used to provide several copies of the same signal to the receiver in order to mitigate fading. In this paper two different types of diversity combining techniques Maximal Ratio Combining and Equal GainCombining have been discussed and a comparison has been made between them with respect to Rayleigh channel. The result shows that maximal ratio combining is a better technique as its SNR is higher than Equal gain combining.

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BIOGRAPHIES

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