Enhanced MIMO Wireless System using ETU Channel with MPSK Scheme

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Abstract - Communication in modern world is one of the most important aspects. People need to be able to send and receive data wherever they are. They also want the data transmission to be as fast as possible. Wireless communication is a way to get rid of the limitations of cabling. Mobile phone is a clear example of wireless communication use in today's life. Recently the increasing demand for improving channel capacity value attract the researcher to work in this direction and use MIMO wireless communication system. MIMO systems which used at both transmitter and receiver side are capable to reduce limitation such as Noise, fading, ISI, BER in a certain extend. Due to gain of spatial multiplexing the communication channel capacity improves. The increased capacity does not take more power as well as bandwidth. a wireless communication system have been modeled in this work utilizing the Alamouti Space Time Block Codes for transition of signal in the space with variations which is integrated with the antenna diversity with utilizing 2 transmitter and 2 receiver antennas. MIMO technology to receive more power than traditional single antenna system. The proposed system is analyzed on the Extended Typical Urban model (ETU) environment which is a modern wireless channel model given by the scientists for modern communication technology. The results of the proposed system it is clearly visible that optimized BER as compared to existing system.

Keyword - ETU, M PSK, STBC, Antenna Diversity.

I. INTRODUCTION

Multiple Input Multiple Output (MIMO) communications techniques have been studied from a long time approximately more than one decade. it has been proved that theoretically that Communication system that use multiple antennas at both the transmitter and receiver have been the subject of much recent research because theoretically they offer improved capacity, coverage, reliability, or combinations compared to systems with a single antenna at either the transmitter or receiver or both. MIMO also offer different benefits, namely beam forming gain, spatial diversity and multiplexing. With beam forming, transmit and receive antenna patterns can be focused into a specific angular direction by the choice of complex baseband antenna weight.

Under line-of-sight (LOS) channel conditions, RX and TX gains add up, leading to an upper limit of m×n for the beam forming gain of a MIMO system (n and m here the number of antenna elements for the receiver Rx and for the transmitter TX respectively).

Basically MIMO stands for multiple inputs multiple outputs. It means multiple antennas on both the side of communication system which is transmitter and receiver.

Fig. 1.1 show above is the basic MIMO Channel block diagram. It shows multiple transmitters at transmit location and multiple receivers at receive location. The MIMO systems are able to increase the capacity of the communication channel in which the signals propagate.

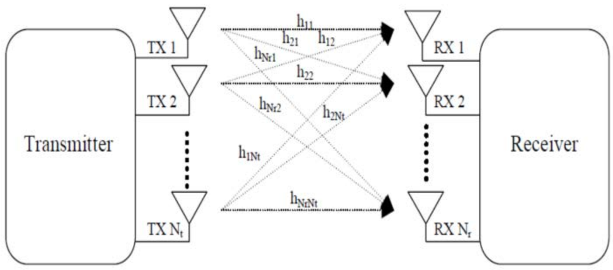

Figure 1.1 MIMO Channel.

The channel matrix for the MIMO systems can be represents as

$$H = \begin{pmatrix} h_{11} & \cdots & h_{1NT} \\ \vdots & \ddots & \vdots \\ h_{NR1} & \cdots & h_{NRNT} \end{pmatrix} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1.1)$$

The format of channel matrix which is providing in equation (1.1) shows the many elements in between transmitter and receiver. These elements are channel gains or complex fading coefficient between transmitter and receiver. We are assuming here that the gains are independent and identically distributed and based on Gaussian random variable have zero mean and unit variance. We are transmitting frame by frame. In between the frame the channel does not change. When the frame of transmitted signal are change the channel are also change. In between the communication system when the channel travels so many obstacles presents which makes the multipath for input transmission signal. So, the received signal at the receiver is the sum of these entire multipath signals.

In m-PSK (or MPSK), the data bits to be modulated are grouped into symbols, each containing log2 m bits, and each symbol can take on one of the m possible values 0, 1,... ,m−1. During each symbol interval the modulator shifts the carrier to one of m possible phases corresponding to the m possible values of the input symbol. In the ideal case, the phases are each 360/m degrees apart.

In Different forms of MIMO-One is multi-antenna type called it as single user type. The special case of MIMO is SISO (single-input-single-output), SIMO (single-input-multiple-output), MISO (multiple -input- multiple -output). In MISO case receiver used only one antenna. While in SIMO case transmitter used only one antenna.

This work design a ,MIMO antenna system with two tramsnitter and two receiver and multiple phase shift keying is applied on it.

II. EXTENDED TYPICAL URBAN MODEL(ETU)

Channel models for urban organizations are among the most regularly utilized as a part of research, standardization, and dimensioning of cell networks. The time scattering has ever been a vital normal for the channel, frequently being the deciding variable while surveying execution, for example, bit error rate and achievable throughput. A related measure is the channel orthogonality factor. the urban radio channel is returned to and the estimation information is contrasted with well-known models [8].

the typical time dispersion in urban deployments is significantly smaller than what is experienced in the 3GPP TU channel model that is often used to represent such scenarios.

The “Typical Urban” channel model [9] has been a piece of the tool kit for specialists and engineers in the wireless communication business since the early years of GSM. This specific model depended on radio channel estimations performed inside the COST 207 activity and was at first used to decide the need and execution of the equalizer in GSM. These estimations were throughout the entire performed before any business GSM networks were put into operation in spite of the fact that there existed systems in light of analog standards.

More late channel demonstrating exercises have concentrated on the spatial attributes of the channel that are applicable for multi-antenna transmitters and beneficiaries, and at models appropriate and practical for framework recreations with numerous base stations and terminals. One of these models is the COST 259 directional channel show [3], [4], whose legacy in the COST 207 models (GSM models) is obvious in the naming of the sub-models: "Summed up Typical Urban" (GTU) and so on. The COST 259 model also inspired the 3GPP/3GPP2 Spatial Channel Model (SCM) [10]. Common to both these models is that they show the fluctuation of the rms delay spread utilizing a separation subordinate log-ordinary appropriation as initially proposed, in spite of the fact that the separation reliance was dropped in the 3GPP/3GPP2 SCM.

All of the depicted models have in like manner that they depend on estimations with committed channel sounding hardware. While the specialists playing out the estimations have attempted to reproduce expected organizations however much as could reasonably be expected there is no certification that the channel conditions caught in the models are extremely illustrative of genuine conditions in an operational wireless system. Specifically, the development in rush hour gridlock and limit requests have prompt wireless networks getting to be plainly denser with time to such an extent that the normal cell estimate in a urban city today is just a small amount of what it was 20 years prior when the estimations in the COST 207 activity were performed. As such, there is a need to approve the notable and all around utilized channel models against average radio spread states of today.

The multipath fading channel model specifies the following three delay profiles [11].

- Extended Pedestrian A model (EPA)
- Extended Vehicular A model (EVA)
- Extended Typical Urban model (ETU)

In the instance of MIMO conditions, an arrangement of relationship networks is acquainted with display the connection amongst's UE and eNodeB antennas. These relationship lattices are presented in MIMO Channel Correlation Matrices.

The high speed train condition characterizes a non-fading engendering channel with single multipath segment, the position of which is settled in time. This single multipath represent to the Doppler move, which is caused because of a fast prepare moving past a base station, as appeared in the accompanying figure 2.1.

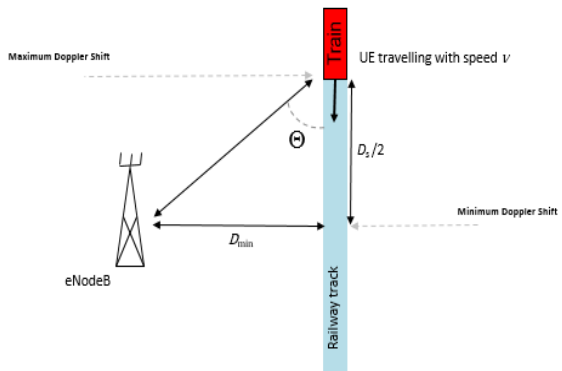

Figure 2.1 Single Multipath dopler Shift.

In MIMO systems, there is relationship amongst's transmit and get antennas. This relies upon various factors, for example, the detachment amongst antenna and the carrier frequency. For greatest limit, it is attractive to limit the relationship amongst's transmit and receiver antennas.

There are distinctive approaches to demonstrate antenna relationship. One method makes utilization of connection lattices to depict the relationship between's different antennas both at the transmitter and the beneficiary. These lattices are registered autonomously at both the transmitter-beneficiary and after that joined by methods for a Kronecker item with a specific end goal to generate a channel spatial relationship matrix.

III. PROPOSED METHODOLOGY

The proposed simulation model for the wireless Almouti scheme with the utilization of ETU channel model is given in the below fig. In the system we have analysed the proposed simulation model with M-ary PSK modulation to modulate the signal. Here this modulation scheme play very important role to fight against the noises and the interferences.

Figure 3.1 has give block diagram of proposed MIMO system using M-arry PSK modulation scheme working of each block has given below

M-PSK Modulation

The M-ary modulation can be seen as an internal code. Normally, when a received signal code symbol is utilized with a M-ary modulation, the quantity of bits per coded symbol m is a number numerous of log2 (M). This constrains the quantity of decisions of the quantity of bits used to speak to a RS symbol. In the event that m is huge, to utilize an extensive M for orthogonal/biorthogonal modulation. This implies a vast data transfer capacity/delay.

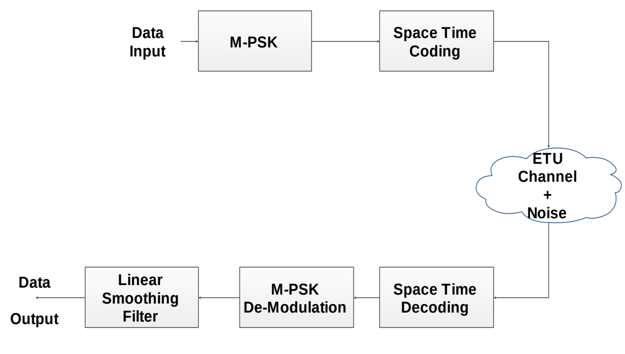

Figure 3.1 Block diagram of Proposed work.

For M- ary phase shift keying modulation this implies a substantial energy . An orthogonal modulation can be seen as mapping (encoding) k data bits into M = 2k coded bits with the end goal that the codewords are orthogonal. Consequently, it is conceivable to think about orthogonal/biorthogonal modulation as a sort of inward code.

For simplicity of discussion, let us call an symbol code an M−ary or log2 M−bit RS code. For this code, the block length can only be at most M + 1. It is natural, though not necessary, to use M−ary modulation for an M−ary symbol code.

Space Time Coding

space-time coding has employed in MIMO system in order to enhance the execution of the framework. At first we will consider the connection between various codes and after that we will give a framework based viewpoint of room time transmission through normal transmitter and collector demonstrate.

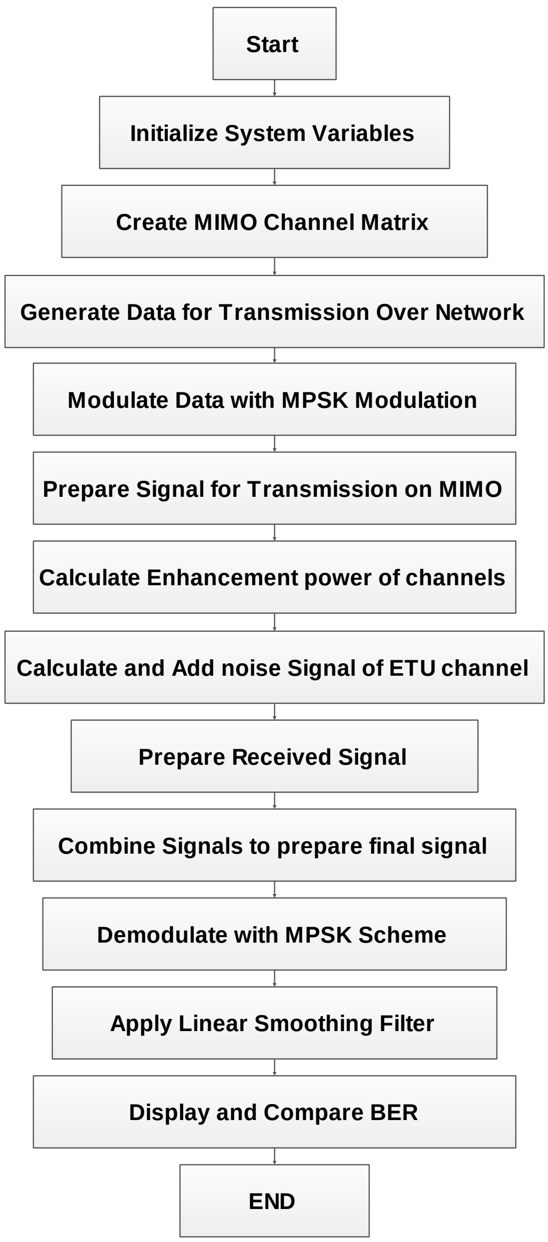

Figure 3.2 Process Flow chart.

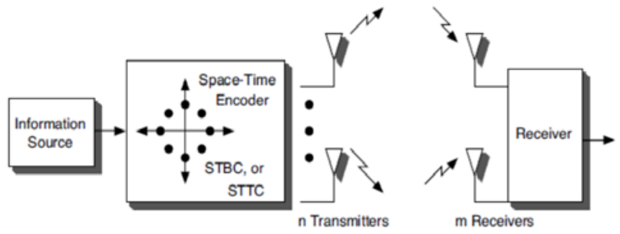

Figure 3.3 System Block diagram STC.

Let us consider a communications framework where the base station is introduced with n transmit antennas and the recipient unit is outfitted with m get antennas it enhance the framework execution by bringing down the bit error rate at wanted signal to noise ratio SNR.

ETU Chanel

ETU channel model is a extended typical urban channel model. Proposed work utilized ETU channel model for the performance evaluation of proposed work.

Space Time Decoding

Space Time decoding is the is the inverse process of space time encoding. At the receiver end received signal are first decoded with space time decoding.

M-psk Demodulation

M-PSK demodulation is the demodulation process for M-array PSK modulated symbols at the receiver end.

Linear Smoothening Filter

A linear Smoothening filter is the filter utilized to remove noise from the received demodulated signals.

The process flow of proposed work has given in figure 3.2 The steps of simulation of proposed work are as given below.

IV. SIMULATION RESULTS

The proposed methodology has been modeled and simulated on the MATLAB and the system analysis on the bit error rate BER has done. The performance of the proposed system between BER and SNR is shown in the subsequent figures.

In Fig. 4.1 performance of the proposed multiple input multiple output (MIMO) space coding with Extended Typical Urban model(ETU) channel model system is analyzed and BER vs SNR is shown with 2 iterations. The whole system is tested for 2-PSK, 4-PSK and 8-PSK and found that the system perform well with 8-PSK Modulation and optimum value is 10^{-5}.

In Fig. 4.2 performance of the proposed multiple input multiple output (MIMO) space coding with Stanford University Interim(ETU) channel model system is analyzed and BER vs SNR is shown with 4 iterations. The whole system is tested for 2-PSK, 4-PSK and 8-PSK and found that the system perform well with 2-PSK Modulation and optimum value is $5x10^{-6}$.

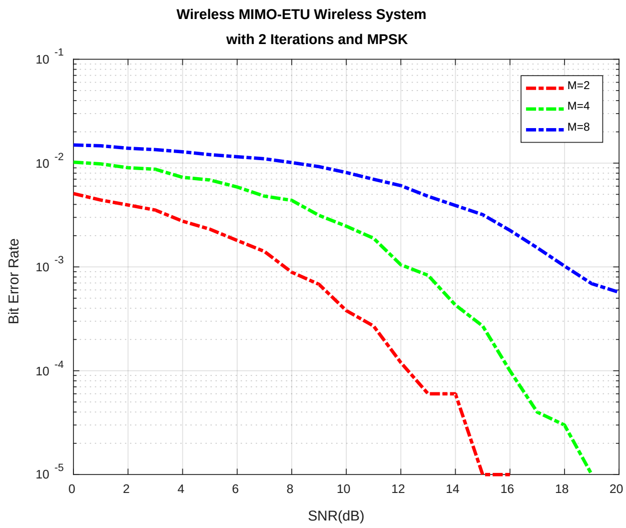

Fig. 4.1 Performance of the system with ETU model and 2 iterations

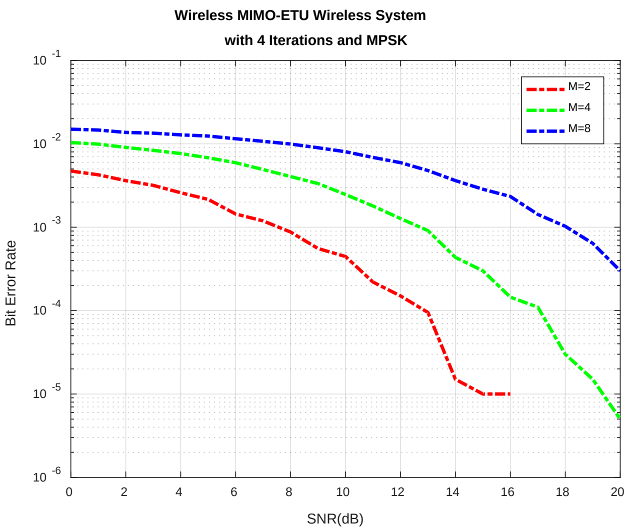

Fig. 4.2 Performance of the system with ETU model and 4 iterations

In Fig. 4.3 performance of the proposed multiple input multiple output (MIMO) space coding with Extended Typical Urban model(ETU) channel model system is analyzed and BER vs SNR is shown with 8 iterations. The whole system is tested for 2-PSK, 4-PSK and 8-PSK and found that the system perform well with 2-PSK Modulation and optimum value is $2.5x10^{-6}$.

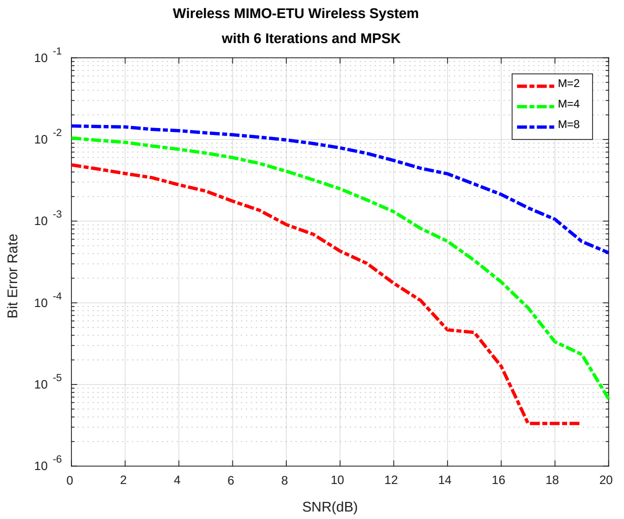

Fig. 4.3 Performance of the system with ETU model and 8 iterations

Table 1: Comparison of BER

SNR	***Bit Error Rate***			
	Previous Work (AWGN Channel)	***Proposed Approach (ETU Channel)***		
		Iteration 6	***Iteration 4***	***Iteration 2***
0	8.10x10^{-2}	4.81x10^{-3}	4.86x10^{-3}	5.01x10^{-3}
1	5.70x10^{-2}	4.21x10^{-3}	4.29x10^{-3}	4.40x10^{-3}
2	4.70x10^{-2}	3.87x10^{-3}	3.70x10^{-3}	3.83x10^{-3}
3	2.50x10^{-2}	3.34x10^{-3}	3.09x10^{-3}	3.32x10^{-3}
4	1.23x10^{-2}	2.79x10^{-3}	2.61x10^{-3}	2.77x10^{-3}
5	6.01x10^{-3}	2.13x10^{-3}	2.29x10^{-3}	2.63x10^{-3}
6	2.41x10^{-3}	1.76x10^{-3}	1.44x10^{-3}	1.81x10^{-3}
7	7.81x10^{-4}	1.33x10^{-3}	1.30x10^{-3}	1.50x10^{-3}
8	1.91x10^{-4}	1.01x10^{-3}	9.30x10^{-4}	8.50x10^{-4}
9	-	6.83 x10^{-4}	6.00x10^{-4}	7.20x10^{-4}
10	-	3.77x10^{-4}	4.05x10^{-4}	4.40x10^{-4}
11	-	3.07x10^{-4}	2.75x10^{-4}	3.00x10^{-4}
12	-	1.47x10^{-4}	1.50x10^{-4}	2.50x10^{-4}
13	-	9.33 x10^{-5}	7.50 x10^{-5}	8.00 x10^{-5}
14	-	3.00 x10^{-5}	4.00 x10^{-5}	5.00 x10^{-5}
15	-	3.00 x10^{-5}	3.00 x10^{-5}	2.00 x10^{-5}
16	-	1.00 x10^{-5}	2.50 x10^{-5}	1.00 x10^{-5}
17	-	6.67 x10^{-6}	-	1.00 x10^{-5}
18	-	3.33 x10^{-6}	-	1.00 x10^{-5}
19	-	3.33 x10^{-6}	-	-

V. CONCLUSION AND FUTURE SCOPE

In the Proposed work a wireless communication system has been designed and implemented on Matlab IDE and Simulated in ModelSim Simulator. Simulation results of the proposed work has been compared with existing work. From the analysis of Simulation outcome of proposed system it can be concluded that the wireless communication system with MIMO technology and the space time coding scheme under the ETU channel environment perform well with the 2-PSK modulation and the optimum value of BER is BER is 1.01x10^{-3} in Iteration 6, 9.30x10^{-4} in Iteration 4, 8.50x10^{-4} against previous work AWGN channel 1.91x10^{-4} its clear visible that noise and effect of fading is reduced with the Space Time coding of the signal which separates the signal into multiple parts which has an inherent security for the signal noise and effect of fading is reduced with the Space Time coding of the signal which separates the signal into multiple parts which has an inherent security for the signal. Further noises is reduced with the Digital Mean Filter which takes averages of the multiple samples and smoothen the glitches presents in the signal. In this research work the proposed system can be further improved in terms of noise resistance as well as better error rate with the integration of more complex and accurate modulation techniques and digital filtering arrangements. Such system can targeted for variety of wireless applications, for example, mobile communications and other mobile data sharing systems.

REFERENCES

[1] M. Raju and K. A. Reddy, "Evaluation of BER for AWGN, Rayleigh fading channels under M-QAM modulation scheme," 2016 International Conference on Electrical, Electronics, and Optimization Techniques (ICEEOT), Chennai, 2016, pp. 3081-3086.

[2] B. L. Ahlem, M. Béchir Dadi and C. Belgacem Rhaimi, "Evaluation of BER of digital modulation schemes for AWGN and wireless fading channels," 2015 World Congress on Information Technology and Computer Applications (WCITCA), Hammamet, 2015, pp. 1-5.

[3] Sharif and S. P. Majumder, "Analytical evaluation of BER of the effect of cross-polarization in a polarization diversity MIMO satellite to ground link," 2015 IEEE International Conference on Telecommunications and Photonics (ICTP), Dhaka, 2015, pp. 1-5.

[4] S. S. Pauline and C. V. Lakshmi, "Evaluation of BER and capacity for ultra wide band communication receivers," International Conference on Information Communication and Embedded Systems (ICICES2014), Chennai, 2014, pp. 1-5.

[5] K. Sharma, A. Verma, J. Kaur and Trishla, "Performance evaluation of fountain codes for MIMO-OFDM system over Rician faded channel," 2014 International Conference on Medical Imaging, m-Health and Emerging Communication Systems (MedCom), Greater Noida, 2014, pp. 319-324.

[6] C. Prieto del Amo and M. J. Fernández-Getino García, "Iterative Joint Estimation Procedure for Channel and Frequency Offset in Multi-Antenna OFDM Systems With an Insufficient Cyclic Prefix," in IEEE Transactions on Vehicular Technology, vol. 62, no. 8, pp. 3653-3662, Oct. 2013.

[7] S. K. Liaw, P. S. Tsai, Z. Ghassemlooy, H. L. Minh and W. F. Wu, "BER evaluation/or 3×3 reconfigurable multiwavelength bidirectional optical cross-connect," 2013 IEEE 4th International Conference on Photonics (ICP), Melaka, 2013, pp. 193-196.

[8] H. Asplund, K. Larsson and P. Okvist, "How Typical is the "Typical Urban" channel model?," VTC Spring 2008 - IEEE Vehicular Technology Conference, Singapore, 2008, pp. 340-343.

[9] 3GPP TS 05.05 V8.20.0 (2005-11). Technical Specification. 3rd Generation Partnership Project;.

[10] C. Mehlführer, M. Wrulich, J. C. Ikuno, D. Bosanska and M. Rupp, "Simulating the Long Term Evolution physical layer," 2009 17th European Signal Processing Conference, Glasgow, 2009, pp. 1471-1478.

[11] https://in.mathworks.com/help/lte/ug/propagation-channel-models.html