An Analysis of Digital Modulation Technique for Image Transmission over Wireless Channel

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Abstract - Reliable and efficient image transmission over wireless channel at low SNR has been a challenge for engineers. To solve this problem study of image processing and digital communication system is carried out. The objective of this study is to provide a sense of perspective on the beginning of image processing in digital communication system and significance on current and forth coming areas of the application of image processing. The input image of origin is applied on the modulation/demodulation techniques such as QPSK, 16-QAM and 64-QAM in the communication system. The advantage of the currently designed system is that, when the channel is under a condition of high noise, the system generates a quality of image worse rather than completely lose the transmitted image. The simulation is performed, when SNR value is 5 dB, 10 dB and 50 dB. By using 64-QAM modulation technique, which carries higher data rates, this is essential for image transmission. Modulation techniques such as 64-QAM provide better results than the other modulation techniques such as QPSK and 16-QAM under condition of higher channel noise with Signal to Noise Ratio is 10 dB.

Keywords:- SNR, QPSK, 16-QAM and QPSK.

I. INTRODUCTION

An image can be defined as a function x and y of two dimensions, where the coordinates space are x and y, and the amplitude of the fats of any (x, y) pair of coordinates is called the image gray level at this point. When x and y values is the amplitude of fare all finished, distinct quantities, than it is called as digital image. The vision is the most advanced of our sense; it is therefore not surprising that images play the main significant task in the human observation. But, different humans, who are restricted to the optical band of the EM, imaging equipment wrap approximately the whole electromagnetic spectrum, from radio to gamma waves. They can activate on the images produced by the origins that humans aren't used to relate with images. These include ultrasound, electron microscopy, and computer generated images. Additionally, image processing in digital covers a broad and changed field in the applications.

The area of the analysis of images (also called the understanding of the image) is in image processing and the computer between visions. There are no clear borders, in the continuum of treatment of images to one end of the vision by computer to the other. However, a useful paradigm is to regard 3 types of computerized procedures: low, medium, process of high level. Process of low level involves primitive operations such as image pre-treatment to reduce the noise, the improvement of contrast, and the definition of the contours. A process of bottom level is categorized by the concept that it's two i/p and o/p images. Therefore the central level of treatment on the images includes such works as the segmentation and the explanation of these things to decrease them to an appropriate form of computer processing and identification of separate things [2]. A process of intermediate level is categorized by the concept with the aim of its i/p's are typically images, but its results are attributes extracts of these images. At last treatment of upper level implies "Making Sense" of a set of known objects, as in the analysis of the image, and, finally the variety of executing the cognitive functions normally associated with the vision.

II. LITERATURE SURVEY

This document analyzes the different techniques of modulation used for the radio performed by software. The DTS technologies are important from the point of communication system future mobile because of its operational capabilities multimode and reconfigurable [17]. The selection of regime of modulation depends on of bit error rate (BER), signal to noise ratio (SNR), and the available bandwidth. The basic criteria for the best technique of modulation are the effectiveness of the power supply, a better quality of service, profitability, the effectiveness of the bandwidth and the complexity of the system. The quality of the service provided by wireless communication services can be greatly improved thanks to the help of correct selection of modulation technique. It will serve to increase the radio coverage, reduce the consumption of energy.

In recent years, an important transition is produced from the modulation techniques analog-to-digital that are currently used in all areas of communication systems by satellite, cellular phones, wireless networks. The modulation is a method which is used to encode digital information into an analogue signal. Although there are various techniques implemented for best performance of modulators but there are still various techniques yet to be implemented for the simple programmable interface for

switching between the different techniques for low power and the consumption of FPGA resources [18]. Here in this paper a complete record of all the techniques implemented for the design of digital modulators and demodulators and their various advantages and disadvantages are discussed such as a new improved technique can be implemented in the future. The proposed methodology implemented here is an effective technique for the implementation of the modulator and demodulator, also the design uses a single demodulator to demodulation of any type of modulation therefore records FPGA of space and resources. But other improvements can be made in the future. This communication technique is supposed to be effective in the noisy environment also.

This document demonstrates the effect of an image transmission by AWGN channel using phase shift key (PSK) system and transmission of compressed images by AWGN channel. Image compression is one of the notable features in wavelet transform. In general, compressed image takes less time & Space for crossing the channel as compare to the original image. Bit error rate (BER) & the root mean square error (RMSE) values decreases, and the Peak Signal/Noise Ratio (PSNR) values increases for different signal to noise ratio (SNR) value on the transmission of the simple image & image compressed by AWGN channel [20]. Table 2.2 shows the results of an iTunes image on AWGN channel. It has been observed that with the increase of SNR values BER values decreases, RMSE values also decreases and values of PSNR increases. Table 2.3 presents the analysis of the performance of the image to gray scale compressed with channel and without channel using WT. It has been observed that with the increase of SNR values BER & RMSE value decreases and PSNR increases with AWGN channel. RMSE & values of PSNR remain constant for without AWGN channel.

Kural E.Yavuz et. al. have done an excellent job in the field of the creation of the best Golay complementary sequences [22]. Nothing in above has implemented the

The last three blocks consisting of detector/Demodulator, a decoder channel, and source of the receiver of form decoder. The destination represents the client waiting for the information. It may be a human or a storage device or to another station of treatment. In all cases, the source of the liability of the decoder is to recover the information of the channel decoder and to transform it into an appropriate format for the destination. This transformation includes the digital to analog conversion (DAC) if the destination is a human being waiting to hem or view the information or if it is a storage device analog. If the destination is a storage device digital, the information will be retained in its digital state without a controller. The channel decoder (demodulator) creates the binary sequence entering

generated sequences Golay with MATLAB to give notice of the actual performance of the system OFDM. It is described in the origin to achieve 4-phase Golay sequences and pairs of sequence of the same Golay length at more than 26. The construction to three floors can be used to obtain counts relating to minimum 4-phase Golay sequences and pairs of sequences of a length of more than 26, but a result more general of Proposal 9 is necessary for certain lengths [23].

This paper present a 4-phase Golay sequence pair of length S=5 (Mode 8) is built from a sequence of Barker of the same length, including even the indexed elements have been prescribed [21]. This has explained how the origin of the 4-phase pairs of seed of Golay length 5 and 13. Through the construction cannot be achieved new 4-phase Golay pairs of sequences, because there are not any of the sequences Barker of o 1 of 13.

III. PROPOSED METHODOLOGY AND SIMULATION RESULTS

The model is a simple model of a wireless digital communications system. The model is broken into its constituents of functions or modules, and each of these in turn is described in terms of its impact on the data and the system. Since this model includes the whole of the system, both the source code and the equalization of the channel are briefly described. Modulation/de-modulation and IFFT/FFT are the main blocks of this wireless digital communications system simplified.

Communication systems than the initial change the output of the source in a binary sequence and after that change this binary sequence in a format proper for transmission on physical media particular, such as the optical fiber, cable, electromagnetic radiation in space and twisted pair cable.

The Digital Communication systems, by description, are of communication systems that utilize such a numeric sequence as an interface involving the input channel and the source.

(hopefully) reliable manner, and the source decoder creates the source output.

IV. SIMULATION RESULTS

The simulation of the proposed algorithm is done in MATLAB. Simulation results are based on different modulation techniques at different values of signal-to-noise (SNR) ratio.

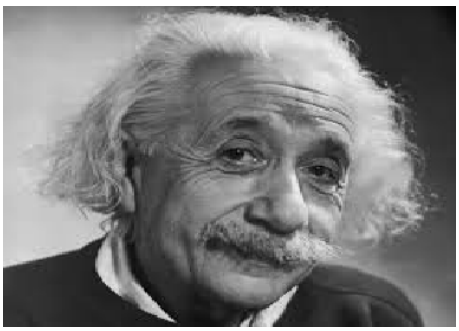


Fig 4.1 ource imge

Reiceved Images at 5db

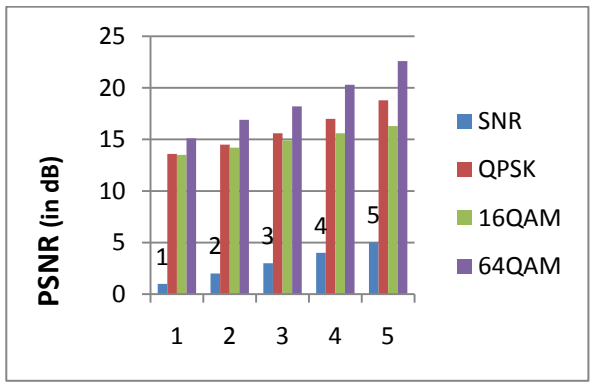
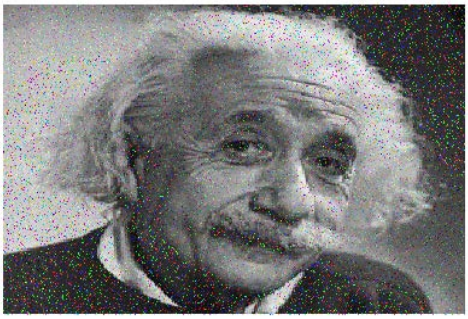
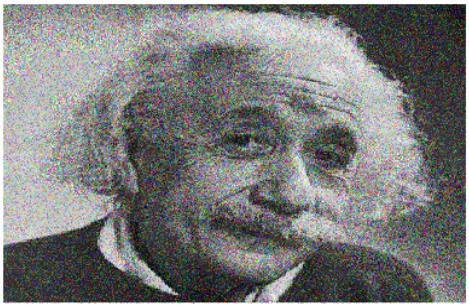


Fig4.5 Bar graph representation of PSNR ,Received Images at 5dB

QPSK



16QAM



64QAM

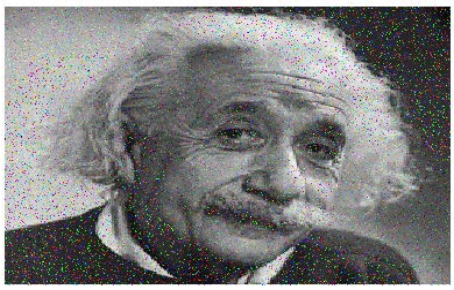
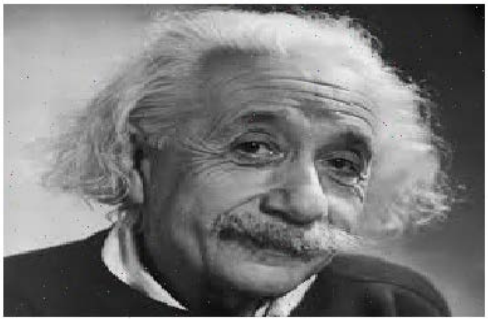


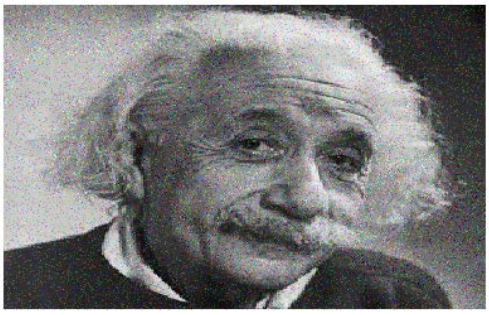
Fig4.4 Received Images at 5dB

Reiceved Images at 10db

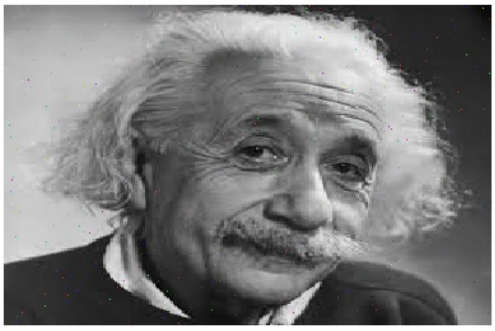
QPSK

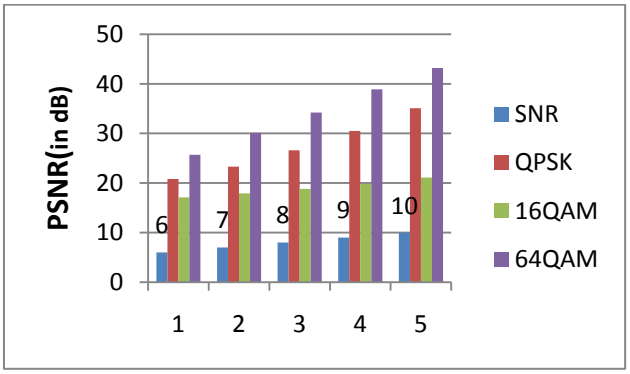


16QAM



64QAM





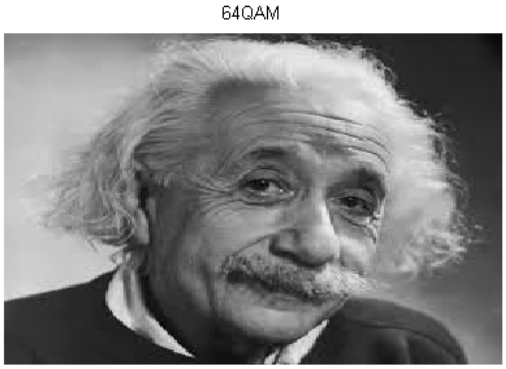
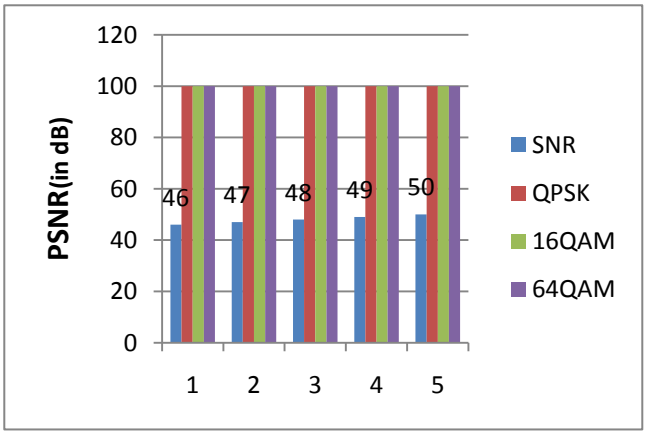
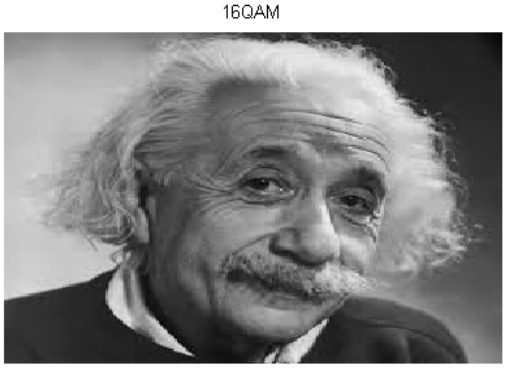


Fig4.7 Bar graph representation of PSNR,Received Images at 10dB

Fig4.8 Received Image at 50dB



(Here 100 Taken as Inf)



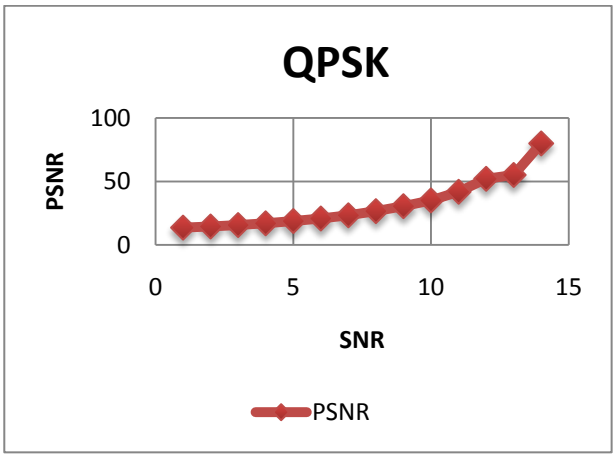


Figure 4.10[a] : in fig 4.10[c] QPSK , PSNR curve approaches to Infinite when SNR approaches to 14 .

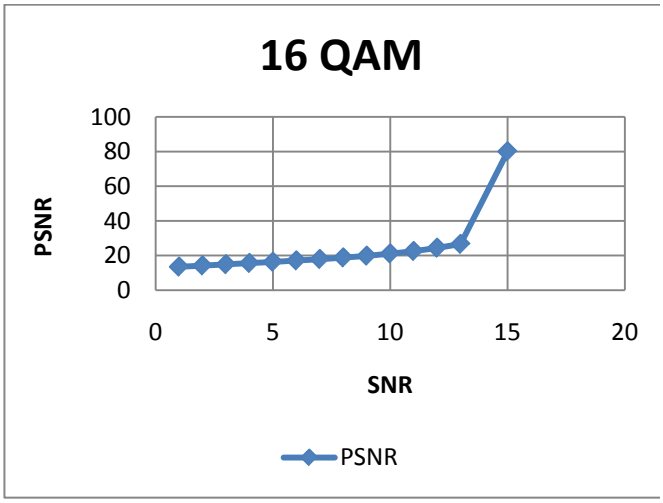


figure4.10 [b] : from figure it can be seen that in 16QAM , PSNR curve approaches to Infinite when SNR approaches to 15 .

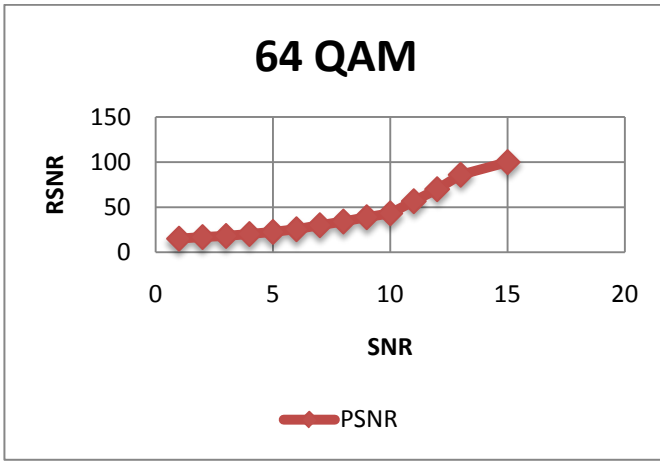


figure4.10[c] IN fig 4.10[c] 64 QAM PSNR reaches to Infinite when SNR is 12 .

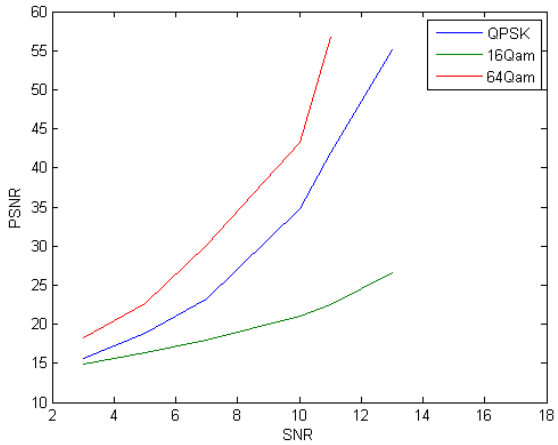


Fig 4.11: PSNR performance for 16 QAM,QPSK and 64QAM Over AWGN Channel

is discussed in this section, containing the results step by step and discussions. The architecture of this wireless transmitter particular is illustrated in Figure 3.1.

The initial phase before the wireless transmission is to transmit the message generated, where this message could be either randomly generated binary values, its audio or image digitally processed. Simulation of this part uses the numbers of pseudo-random distributed evenly, using the "rand(m,n)" which produces a Function 1 by 2500 values pseudo-random, where 2500 represent the number of bits. In order to produce the binary values random, the products previously the values should be rounded to the nearest whole number value. This is achieved by the use of function "round", which product 1 by 2500 bits (ones and zeros).

The kernel of the wireless transmitter is the Modulator, which allows you to modulate the Input data stream image by image. The data are divided into images based on the variable symbol by frame, which corresponds to the number of symbols by image by carrier. However, the number of carriers could not be much larger than 1000 in this simulation, therefore the total number of symbols per frame would generally be of less than 10,000 inhabitants. It is an experimentally number of reasonable symbols a frame must keep for this program of MATLAB to operate effectively. If the total number of symbols in a stream of data to be transmitted is less than the total number of symbols per frame, the data would not be divided into frames and would be modulated all at once.

The simulation results are performed, when SNR value is 5 dB, 10 dB and 50 dB. By using 64-QAM modulation technique, which carries higher data rates, this is essential for image transmission. Modulation techniques such as 64-QAM provide better results than the other modulation techniques such as QPSK and 16-QAM under condition of higher channel noise with Signal to Noise Ratio is 10 dB. From figure 4.5, When SNR value is 40 dB, cannot identify which technique is better because all results are almost same. Table 4.1 shows the comparison of noise mitigation using various digital modulation techniques at SNR values are 10 and 40 dB.

Table 4.2: Comparisons of PSNR values at different SNR

SNR	QPSK	16QAM	64QAM
1	13.60	13.50	15.10
2	14.50	14.20	16.90
3	15.60	14.90	18.20
4	17	15.60	20.30
5	18.80	16.30	22.60
6	20.80	17.10	25.70
7	23.30	17.90	30.10
8	26.60	18.80	34.20
9	30.50	19.80	38.90

10	35.10	21.10	43.20
11	41.90	22.50	56.70
12	52.10	24.40	Inf
13	55.10	26.60	Inf
50	Inf	Inf	Inf

V. CONCLUSION

The simulation results are performed, when SNR value is 10 dB. By using 64-QAM modulation technique, which carries higher data rates, this is essential for image transmission. Modulation techniques such as 64-QAM provide better results than the other modulation techniques such as QPSK and 16-QAM under condition of higher channel noise with Signal to Noise Ratio is 10 dB. The image transmission over communication system using digital modulation techniques is performed and the results are obtained through a high level technical language called MATLAB. MATLAB was introduce for designing and implementing wireless digital communication system. Like many of the other wireless digital communication systems, the performance of this system is acceptable that, up to a certain level of noise from the critical channel.

REFERENCES

[1] Bin Tan, Xinlin Huang, Jun Wu and Pengfei Xia, "An Adaptive Hybrid Digital-Analog Modulation Scheme," in IEEE International Conference on Signal and Information Processing, pp. 766-771, 2015.

[2] Patrick J. Langfeld and Klaus Dostert, "OFDM system synchronisation for power line communications," International Symposium on Power Line Communications (ISPLC), pp. 15– 22, 2012.

[3] Andrew J. Viterbi and Jim K. Omura, "Principles Of Digital Communication And Coding," McGraw-Hill, Inc, pp. 16-30, 2011.

[4] M. Noh, Y. Lee and H. Park, "Low complexity LMMSE channel estimation for OFDM," IEEE Proceeding Communication, vol. 13, no. 5, pp. 645–650, 2011.

[5] G. Avril, M. Tlich, F. Moulin, A. Zeddam, and F. Nouvel, "Time/Frequency Analysis of Impulsive Noise on Power line Channels," International Symposium on Power Line Communications (ISPLC), pp. 14–150, 2010.

[6] Lawrence E Larson, "RF and Microwave Circuit Design for Wireless Communications; Artech House," ISBN 0-89006-818-6, 1996.

[7] Feher, "Applications of Digital Wireless Technologies to Global Wireless Communications," Prentice Hill, ISBN 0-13-214272-4, 1997.

[8] J. G. Smith, "Spectrally efficient modulation," in Proceeding IEEE International Conf. Communication (ICC), pp. 37-41, 1977.

[9] A.N. raydeck and C.E. Sundberg, "Continuous Phase Modulation Part-1: Full Response Scaling," IEEE Transactions on Communications, vol. 29, no. 3, pp. 210-225, 1981.

[10] S. Haykin, "Digital Communication," John Wiley & Sons, Inc., Replika Press Pvt. Ltd., N. Delhi, India, 2000-2001.

[11] T. Aulin and W.C. Sundberg, "Continuous Phase Modulation Part-I: Full Response," IEEE Transactions on Communications (Legacy, pre-1988), vol. 29, no.3, pp.196-209, 1981.

[12] H. Meng, Y. L. Guan and S. Chen, "Modeling and Analysis of Noise Effects on Broadband Power-Line Communications," IEEE Transactions on Power System, vol. 20, no. 2, pp. 630–637, 2010.

[13] G. Avril, M. Tlich, F. Moulin, A. Zeddam, and F. Nouvel, "Time/Frequency Analysis of Impulsive Noise on Power line Channels," International Symposium on Power Line Communications (ISPLC), pp.143–150, 2010.

[14] C. E. Shannon, "A Mathematical Theory of Communication," the Bell System Technical Journal, vol. 27, pp. 379–423, 2008.

[15] F. R. P. Cavalcanti and S. Andersson, "Optimizing Wireless Communication Systems," Springer Science. pp. 353-356, 2009.

[16] A.R.S. Bahai, B. R. Saltzberg and M. Ergen, "Multi-Carrier Digital Communications: Theory and Application of OFDM," 2nd edition: Springer Science, pp. 55 – 68, 2004.

[17] Rajesh R. Bhambare and Rajeshree D. Raut, "A Survey on Digital Modulation Techniques for Software Defined Radio Applications," International Journal of Computer Networks and Wireless Communications, vol. 3, no. 3, 2013.

[18] Sonal Agrahari, Shravan Kumar Sable and Rita Jain, "A Survey of Designing an Efficient Digital Communication System Using Different Modulation Schemes," International Journal of Emerging Technology and Advanced Engineering, vol. 4, no. 6, 2014.

[19] Byeong Gwon Kang, "Design and Implementation of Software Defined Radio Scheme Based Modem for High-Speed Multimedia Data Services," IEEE Region 10 Conference on Computers, Communications, Control and Power Engineering, vol. 2, pp.889-892, 2002.

[20] Reeta Charde, "Image Performance over AWGN Channel Using PSK System," International Journal of Engineering and Innovative Technology (IJEIT), vol. 2, no. 1, 2012.

[21] J. Isabona, and M. E. Ekpenyong, "Data Transmission of OFDM Wireless Networks: an Optimization Perspective," World Journal of Applied Science and Technology, vol. 2, no.1, pp. 87-97, 2010.

[22] E.Yavuz, F. Kural, N. Coban, B. Ercan and M. Safak, "Modelling of Power Lines for Digital Communication,"

International Symposium on Power Line Communications (ISPLC), pp. 161–168, 2012.

[23] Aníbal Luis Intini, "Orthogonal Frequency Division Multiplexing for Wireless Networks," Standard IEEE 802.11a, MSc Thesis, University Of California, 2009.

[24] Dan Raphaeli and Evgeni Bassin, "A Comparison between OFDM, Single Carrier, and Spread Spectrum for High Data Rate PLC," ISPLC, pp. 162–168, 2011.

[25] H. Nikookar and R. Prasad, "On the Sensitivity of Multicarrier Transmission over Multipath Channels to Phase Noise and Frequency Offset," In Proceedings of IEEE International Symposium on Personal, Indoor, and Mobile Radio Communications, pp. 68–72, 2010.

[26] Wei Chen., "Time Frequency Selective Channel Estimation of OFDM Systems," PhD thesis, Drexel University, pp. 6-19, 2005.

[27] Richard van Nee and Ramjee Prasad, "OFDM for Wireless Multimedia Communications," Artech House Inc., pp. 33–55, 2000.

[28] Chang R. W., "Synthesis of Band Limited Orthogonal Signals for Multichannel Data Transmission," Bell System Technical Journal, vol. 45, pp. 1775-1796, 1966.

[29] R. Pandey, K. Pandey, "An Introduction of Analog and Digital Modulation Techniques in Communication System," Journal of Innovative Trends in Science Pharmacy & Technology, vol. 1, 2014.

[30] P. Aulin and W.C. Sundberg, "Continuous Phase Modulation Part-1: Full Response Signaling," IEEE Transactions on Communications, vol. 29, no. 3, pp 196-209, 1981.

[31] S.Haykin, M. Moher, "Introduction to Analog and Digital Communications," John Wiley & Sons, Inc., 2007.

[32] Matlab 6.1, "Image Processing Toolbox," http://www.mathworks.com/access/Help desk/ Help/toolbox/images/images.shtml.

[33] Scott E Umbaugh, "Computer Vision and Image Processing," Prentice Hall PTR, New Jersey, 1998.

[34] Langis Gagnon, "Wavelet Filtering of Speckle Noise-Some Numerical Results," Proceedings of the Conference Vision Interface, Trois-Riveres, 1999.

[35] 1/f noise, "Brownian Noise," http://classes.yale.edu/99-00/math190a/OneOverF.html, 1999.

[36] R.R. Mosier and R.G. Clabaugh, "A Bandwidth Efficient Binary Transmission System," IEEE Trans., vol. 76, pp. 723–728, 1958.

[37] Abhijit Palekar, "OFDM system Using FFT and IFFT," IJARCSSE, vol. 3, no. 12, 2013.

[38] Langton, C., "All about Modulation," Pearson Publications, 1999.

[39] De Buda, R., "A Comparison of Two Digital Modulation Techniques," IEEE Trans. on Communications, vol.1, pp 429-335, 1996.

[40] Rohan D Jahagirdar and Aditya Narendra Ukey, "Study of Digital Modulation Techniques," IEEE Transactions on Communications, vol. 8, pp. 312-322, 2010.