

Simulation of BPSK Modulation and Demodulation on System Generator

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Abstract: In this paper we present a theoretical analysis about communication and theoretical analysis about both analog communication and digital communication. In, this paper we took modulation as a main stream and analyzed about BPSK Modulation technique on Xilinx System Generator 10.1 software on Mat lab Simulink Environment. The BPSK (Binary Phase Shift Keying) is one of the three basic binary modulation techniques. It has as a result only two phases of the carrier, at the same frequency, but separated by 180°. The aim of the paper is to generate BPSK modulation which is a popular modulation technique used in communication industry. BPSK (also sometimes called PRK, Phase Reversal Keying, or 2PSK) is the simplest form of phase shift keying (PSK). It uses two phases which are separated by 180° and so can also be termed 2-PSK.

Keywords: Modulation, Demodulation, BPSK, Xilinx System Generator

1. Introduction

1.1 Communication

Communication is that the activity of transference data through the exchange of thoughts, messages, or data, as by speech, visuals, signals, writing, or behaviour. It is the significant exchange of data between 2 or a bunch of individuals. One definition of communication is "any act by that one person provides to or receives from another person data this person's wants, desires, perceptions, knowledge, or affection states. Communication is also intentional or unintentional, might involve standard or unconventional signals, might take linguistic or non linguistic forms, and should occur through spoken or different modes. Communication needs a sender, a message, and a recipient, though the receiver does not need to be gift or alert to the sender's intent to speak at the time of communication; so communication will occur across large distances in time and area. Communication needs that the communication parties share a vicinity of communicative commonality. The communication method is complete once the receiver has understood the message of the sender.

2. Analog Communication

Analog Communication is a transmission method of conveying voice, data, image, signal or video information using a continuous signal which varies in amplitude, phase, or some other property in proportion to that of a variable. It could be the transfer of an analog source signal, using an analog modulation method such as Frequency modulation (FM) or Amplitude modulation (AM), or no modulation at all.

Consider pass band data transmission using a digital modulation methods such as ASK, PSK and QAM, i.e. a sine wave modulated by a digital bit-stream, as analog transmission and as an analogy signal. Others define that as digital transmission and as a digital signal. Baseband data transmission using line codes, resulting in a pulse train, are always considered as digital transmission, although the source signal may be a digitized analog signal.

3. Digital Communication

Digital transmission or knowledge transmission historically belongs to telecommunications and technology. Basic principles of information transmission may additionally be lined among the pc science/computer engineering topic of information communications that additionally includes laptop networking or laptop communication applications and networking protocols, for instance routing, switch and inter-process communication. though the Transmission management protocol (TCP) involves the term "transmission", TCP and different transport layer protocols square measure usually not mentioned in an exceedingly textbook or course regarding knowledge transmission, however in laptop networking.

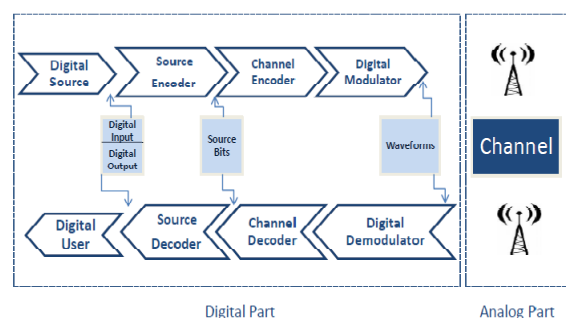


Figure 1: Communication Block Diagram

The term tele-transmission involves the analog also as data communication. In most textbooks, the term ANalog transmission solely refers to the transmission of AN analog message signal (without digitization) by suggests that of an analog signal, either as a non-modulated baseband signal, or as a passband signal victimisation AN analog modulation technique like AM or FM. it should additionally embrace analog-over-analog pulse modulated baseband signals like pulse-width modulation. in an exceedingly few books among the pc networking tradition, "analog transmission" additionally refers to passband transmission of bit-streams victimisation digital modulation ways like FSK, PSK and raise. Note that these ways square measure lined in textbooks named digital transmission or knowledge transmission.

4. Binary Phase Shift Keying

BPSK (also typically known as PRK, part reversal keying, or 2PSK) is that the simplest type of part shift keying (PSK). It uses 2 phases that area unit separated by 180° then can even be termed 2-PSK. It doesn't significantly matter specifically wherever the constellation point's area unit positioned, and during this figure they're shown on the \$64000 axis, at 0° and 180°. This modulation is that the sturdiest of all the PSKs since it takes the best level of noise or distortion to form the rectifier reach associate incorrect call. It is, however, solely able to modulate at one bit/symbol (as seen within the figure) then it is unsuitable for high data rate applications

4.1 BPSK Modulation and demodulation

In the presence of AN absolute phase-shift introduced by the communications channel, the detector is unable to inform that constellation purpose is that. As a result, the info is commonly differentially encoded before modulation. BPSK is functionally equivalent to 2-QAM modulation. Implementation

The general form for BPSK follows the equation:

$$s_n(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_c t + \pi(1 - r_n)), r_n = 0, 1.$$

This yields two phases, 0 and π . In the specific form, binary data is often conveyed with the following signals:

$$s_0(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_c t - \pi) = -\sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_c t)$$

for binary "0"

$$s_1(t) = \sqrt{\frac{2E_b}{T_b}} \cos(2\pi f_c t)$$

for binary "1"

where f_c is the frequency of the carrier-wave.

Hence, the signal-space can be represented by the single basis function

$$\phi(t) = \sqrt{\frac{2}{T_b}} \cos(2\pi f_c t)$$

where 1 is represented by $\sqrt{E_b}\phi(t)$ and 0 is represented by $-\sqrt{E_b}\phi(t)$. This assignment is, of course, arbitrary. This use

of this basis function is shown at the end of the next section in a signal timing diagram. The topmost signal is a BPSK-modulated cosine wave that the BPSK modulator would produce. The bit-stream that causes this output is shown above the signal (the other parts of this figure are relevant only to QPSK).

Bit error rate: The bit error rate (BER) of BPSK in AWGN can be calculated as [5]:

$$P_b = Q\left(\sqrt{\frac{2E_b}{N_0}}\right) \text{ or } P_b = \frac{1}{2} \operatorname{erfc}\left(\sqrt{\frac{E_b}{N_0}}\right)$$

Since there is only one bit per symbol, this is also the symbol error rate.

5. BPSK System in Simulink

In BPSK modulator and rectifier is implemented within the Simulink setting for a sensible teaching course Figure 1 represents a communication system implemented within the Matlab/Simulink setting that uses the BPSK modulation technique. The system consists of the binary knowledge supply, a modulator; a channel and a rectifier. The binary knowledge supply is formed of a random knowledge supply and a miscalculation operate (figure 6). The corresponding signal is illustrated in figure 7c.

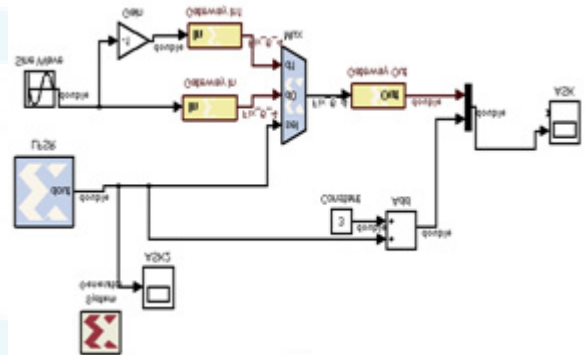


Figure 2: BPSK on mat lab Simulink

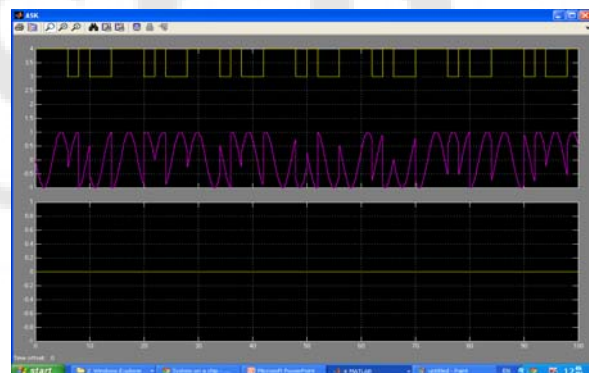


Figure 3: Simulation Wave form

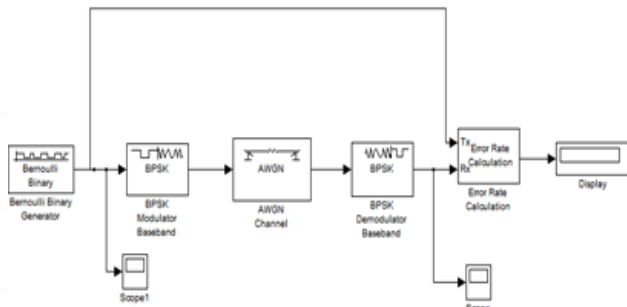


Figure 4: BPSK Demodulators

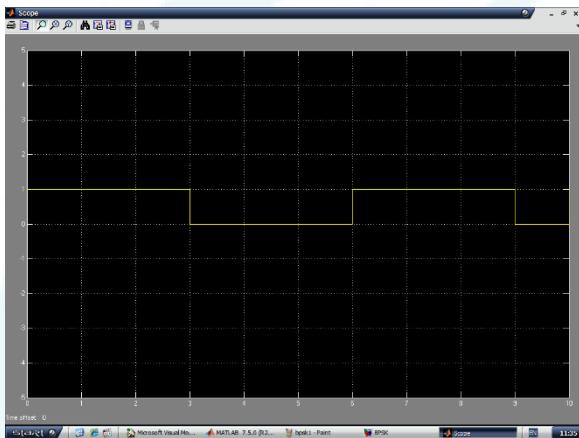


Figure 5: BPSK Demodulated Wave

6. Conclusion

In this paper we implemented a BPSK modulation technique in the Xilinx System Generator using Mat lab Simulink environment. We proposed a implementation of the BPSK System (Modulator and Demodulator) in the Matlab/Simulink environment. Then, we made a proposal of a BPSK System in System Generator. Both, the modulating signal and the carrier are generated internal, the modulating signal by a LFSR and the carrier by a DDS Compiler. The modulated signal is obtained at the output of a mux block and, then, passed through a communication channel where noise is added. In the demodulator, the carrier is recovered due to another DDS compiler and then multiplied with the modulated signal affected by noise. The obtained signal is then added with all the multiplied samples from the carrier in a period. The operation takes place in the accumulator. Once we have a result, it is compared with a decision threshold. If the compared signal is positive, the demodulator take the decision that '1' was transmitted, otherwise, '0'.

References

[1] W. Song, J. Zhang, Q. Yao, "Design and Implementation of BPSK Modulator and Demodulator on Modern DSP Technology", 3rd IEEE International Symposium on Microwave, Antenna, Propagation and EMC Technologies for Wireless Communications, China, 2009, pp.1135-1137.
 [2] Y. Tachwali, H. Refai, "Implementation of a BPSK Transceiver on Hybrid Software Defined Radio

Platforms", 3rd International Conference on Information and Communication Technologies: From Theory to Applications, Syria, 2008, pp. 1-5.
 [3] A. Gürgör, F. Arikan, O. Arikan, "Simulation of a digital communication system", in Proceedings of the 13th European
 [4] Signal Processing Conference EUSIPCO, 2005, Turkey, <http://www.eurasip.org/Proceedings/Eusipco/Eusipco2005/defevent/papers/cr1142.pdf>
 [5] H. Nguyen, E. Shwedyk, A first Course in Digital Communications ,Cambridge University Press, New York, 2009.
 [6] J.G. Proakis, Digital Communications, 4th edition, McGraw Hill, New York, 2001.
 [7] G. Smithson, "Introduction to Digital Modulation Schemes", in IEEE Colloquium on The Design of Digital Cellular Handsets, 1998, United Kingdom, pp. 2/1 - 2/9
 [8] S. O. Popescu, G. Budura, A. S. Gontean, "Review of PSK and QAM– Digital Modulation Techniques on FPGA", International Joint Conference on Computational Cybernetics and Technical Informatics (ICCC-CONTI), Romania, 2010, pp.327-332.
 [9] F. Xiong, "Digital Modulation Techniques", Artech House, UK, 2000.
 [10] S. O. Popescu, A. S. Gontean, F. Alexa, "Improved FPGA-Detector", in Proceedings of the 6th IEEE International Symposium on
 [11] Applied Computational Intelligence and Informatics (SACI 2011), Romania, 2011, pp.455-458.
 [12] S. O. Popescu, A. S. Gontean, G. Budura, "Simulation and Implementation of a BPSK Modulator on FPGA", in Proceedings of the 6th IEEE International Symposium on Applied Computational Intelligence and Informatics (SACI 2011),Romania, 2011, pp.459-463.
 [13] S. O. Popescu, G. Budura, A. S. Gontean, "Review of PSK and QAM– Digital Modulation Techniques on FPGA", International Joint Conference on Computational Cybernetics and Technical Informatics (ICCC-CONTI), Romania, 2010, pp.327-332.
 [14] F. Xiong, "Digital Modulation Techn [16] S. T. Karris, "Introduction to Simulink with Engineering Applications", Orchard Publications, USA, 2006.
 [15] System Generator for DSP. Getting Started Guide. Xilinx. 2008iques", Artech House, UK