Lab 3. Binary Phase Shift Keying

Total marks: 5 marks

1. Lab introductions

The aim of this lab is to explore one of the simplest types of passband digital modulation: binary Phase Shift Keying (PSK). In this laboratory exercise, BPSK modulation/demodulation and its spectral characteristics will be the topic.

This lab consists of two experiments, namely Experiment 1 –ASK/BPSK modulation, and Experiment 2 –BPSK demodulation. In experiment 1, modulators of ASK and BPSK are to be constructed, and based on which the differences of their spectral characteristics will be studied. In experiment 2, coherent demodulator of BPSK is to be constructed, and its error probability with carrier phase offset will be studied. Both experiments are carried out in the platform of **Matlab-Simulink**. You can access Matlab 2019b in UNSW myAccess without installing the software in your own computer. For instructions, please see Appendix A.

Simulation source files, i.e., BPSKModulation.SLX, BPSKDemodulation.SLX**,** and video demonstration are provided to assist you in this lab. What you need to do with the provided source files is to change the parameters as per Quiz Questions, and observe the output. **A report that addresses Quiz Questions is expected as the output of this lab, and based on which a mark will be given as part of the assessment of this course.**

(a) Experiment 1. ASK/BPSK modulation

Open the file BPSKModulation.SLX in MATLAB 2019b, which is available in the link below.

https://weiwang-wys.github.io/files/Lab3/BPSKModulation.slx

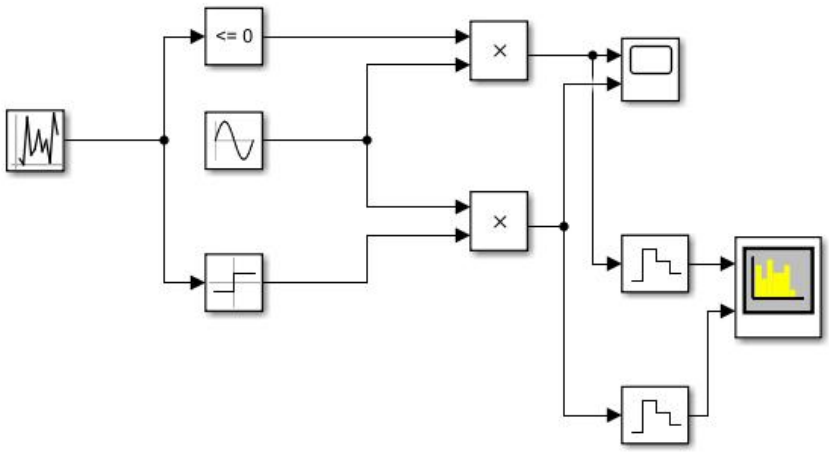


Fig. 3.1 Generation of ASK signal and BPSK signal (BPSKModulation.SLX)

Descriptions of each module in Fig. 3.1 are given in Appendix B. In this experiment, data rate of Binary Sequence Generator is set as R = 500 bps, and frequency of sine wave generator (carrier frequency) is set as f= 8kHz. For detailed instruction, please watch the following video.

https://weiwang-wys.github.io/files/Lab3/lab3a.mp4

Quiz Question 1. Please observe the spectrums of ASK and BPSK, and paste them in your lab report. What is the difference between their spectrums and what factor may cause the difference?

(b) Experiment 2. BPSK demodulation

Open the file BPSKDemodulation.SLX in MATLAB 2019b, which is available in the link below.

https://weiwang-wys.github.io/files/Lab3/BPSKDemodulation.slx

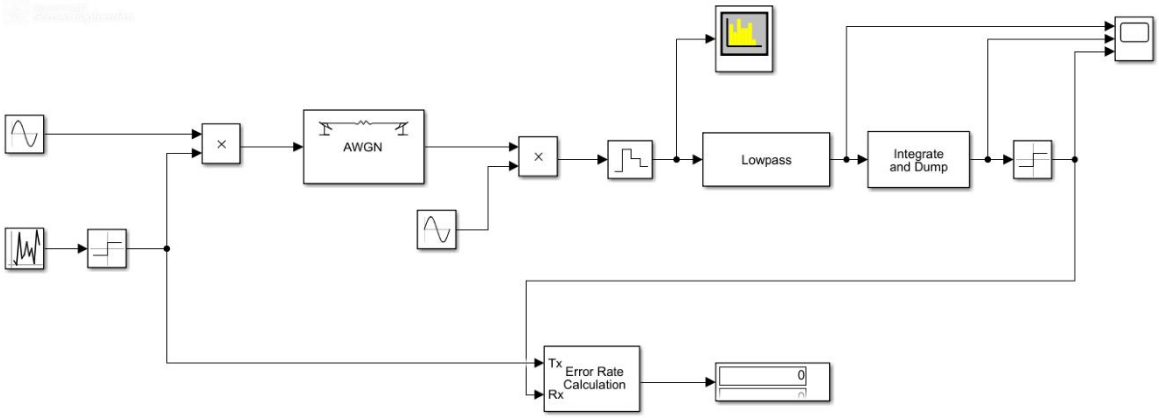


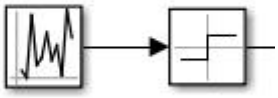
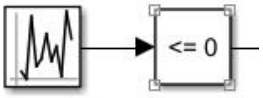
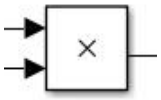
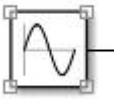
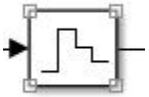
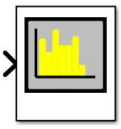
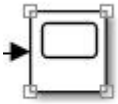
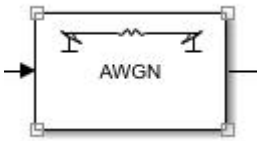
Fig. 3.2 BPSK demodulation (BPSKDemodulation.SLX)

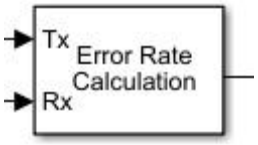
Descriptions of each module in Fig. 3.2 are given in Appendix B. In this experiment, data rate of Binary Sequence Generator is set as R = 1000 bps, and frequency of sine wave generator (carrier frequency) is set as f= 8kHz. For detailed instruction, please watch the following video.

https://weiwang-wys.github.io/files/Lab3/Lab3b.mp4

Quiz Question 2. Plot the Error Rate curve with SNR = -20:2:0 dB when phase offset between carrier and the local oscillator is 0 rad, pi/6 rad and pi/3 rad, respectively. What is the impact of carrier phase offset on the error rate of BPSK demodulation? Please explain mathematically.

Appendix A-- Description of modules

	Binary sequence generator which generates random binary sequence with the values -1 and 1.
	Binary sequence generator which generates random binary sequence with the values 0 and 1.
	Multiplier
	Sine wave generator
	Zero-order hold, which works as a sampler (a.k.a ADC, analog-to-digital converter)
	Spectrum Analyzer
	Scope
	Additive white Gaussian noise (AWGN) channel
	Lowpass Filter

	Integrate and Dump: Integrate over the number of samples in the integration period and reset at the end of the integration.
	Error Rate Calculator, which computes the error rate of the received data by comparing it to a delayed version of the transmitted data.