Text

Description automatically generated with medium confidenceDigital Communication Systems

**Laboratory Report**

Fall 2021

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| Laboratory Number: | **04** |
| Laboratory Title: | **Baseband Transmission and Detection** |
| Full Name: | **Robert Louis Bara** |
| TUID: | **915614617** |

**Description:**

This lab is a two-week lab exploring baseband transmission and detection. The lab discusses waveform encodings, explaining that a waveform can be assigned to a symbol, therefore the waveform gets transmitted instead of the symbol. The symbol may be encoded three different ways,

* Amplitude Shift Keying (ASK)
* Frequency Shift Keying (FSK)
* Phase Shift Keying (PSK)

Upon decoding, various detection methods such as the correlation decoder can be used to detect as follows,

where is a detection, is the received signal with respect to time and is the base encoded signal.

Noise can affect the transmitting/receiving process. The most common way to find the noise impact is to generate White Gaussian Noise to be added to the transmitted signal. This lab will take a randomly generated message with a fixed length and transmit the signal using the ASK method. The White Gaussian Noise transmitted will then be detected and compared to the original signal to determine the signal to noise ratio and mean absolute error rate.

**Numerical Tables:**

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| --- | --- |
| 4-ASK | |
| SNR | Mean Absolute Error |
| 20 | 0 |
| 16 | 0 |
| 8 | 0 |
| 4 | 0 |
| 2 | 0 |
| 0 | 0 |
| -2 | 0 |
| -4 | 0 |
| -8 | 0 |
| -16 | 0.004 |
| -20 | 0.087 |

**Code:**

### Section 01

The initial parameters are usually defined at the beginning of the program.

%TUID 915614617

clc; clear;

A = 8; % Signal amplitude

rb = 2000; % Fundamental frequency of signal

Tb = 1 / rb; % Period of signal

fs = 1000 \* rb; % Sampling frequency

Ts = 1 / fs; % Sampling period

Section 06 is then modified to take in 1000 samples

% generation of a random message with fixed length

rng(0);

Nm = 1000;

symbol\_set = [1, 2, 3, 4]; % symbols' indices

symbol\_amplitude = [-A, -A/2, +A/2, +A]; % symbols' amplitude

msg = randi(M, [1, Nm]); % message: a set of symbols

figure(); stem(msg);

SNR is then modified to take in the inputs to the table and compared using the sample code’s computation for error rate.

snr = -20;

noisy\_signal = awgn(signal, snr, 'measured');

figure(); plot(noisy\_signal);