Text

Description automatically generated with medium confidenceDigital Communication Systems

**Laboratory Report**

Fall 2021

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| Laboratory Number: | **06** |
| Laboratory Title: | **Phase Shift Keying** |
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**Description:**

This week’s lab explores Phase Shift Keying (PSK). PSK encoding can be performed by using at least 4bits. Using PSK allows the phase of the sinusoid to be changed by the symbols transmitted, where each symbol equals a phase angle . The PSK transmission works similarly to the previous transmissions by using a carrier wave to modulate the message. The PSK can conveniently be viewed using a constellation diagram which gives the maximum phase-separation between adjacent points while representing a complex plane with real and imaginary axes. The amplitude along the in-phase axis will be used to modulate a cosine wave, while the quadrature amplitude axis is used to modulate a sine wave. The PSK can be transmitted and the received signal works by detecting the phase encoded symbols and decoding the signal and noise transmitted. From this, the signal to noise ratio can be calculated and observed.

**Images:**

Observing the appropriate thresholds for 4PSK.

A picture containing chart

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Figure . Appropriate Thresholds for 4PSK

**Numerical Tables:**

Generating 1000 samples and observing the SNR in a 4PSK transmission.

Table . 4-PSK SNR vs Mean Absolute Error

|  |  |
| --- | --- |
| 4-PSK | |
| SNR | Mean Absolute Error |
| 20 | 0 |
| 8 | 0 |
| 0 | 0 |
| -8 | 0 |
| -16 | 0 |
| -20 | 0 |
| -24 | 0.0250 |

**Code:**

### Section 01

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

clc; clear; %915614617

A = 1; % Signal amplitude

rb = 2000; % Fundamental frequency of signal

Tb = 1 / rb; % Period of signal

fc = (6+20) \* rb;

Tc = 1 / fc;

fs = 100 \* fc; % Sampling frequency

Ts = 1 / fs; % Sampling period

### Section 03

#### Phase Shift Keying (ASK)

Suppose there are 4 symbols in the symbol set. Therefore, at least 4 bits are needed to encode the symbols in binary format.

M = 4; % Number of symbols

Nb = ceil(log2(M)); % Number of bits per symbol

In PSK encoding, the phase will carry the information. So, the phase of the sinosoid will be changed by the symbols.

For example:

Shape

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This symbol sets can be shown in the original indices and the PSK encoded format:

symbol\_set = 1:M; % symbols' indices

TUID6=4;

%symbol\_phase=[pi+5\*TUID6,((pi/2)+5\*TUID6),(pi+5\*TUID6),(3\*pi+5\*TUID6)] %symbol phases using my TUID

symbol\_phase = [pi/4, 3\*pi/4, 5\*pi/4, 7\*pi/4]; % symbols' phase

figure();

subplot(2, 1, 1); stem(cos(symbol\_phase));

subplot(2, 1, 2); stem(sin(symbol\_phase));