**Digital Communication Systems Laboratory**

**Fall 2021**

**Laboratory 05: Passband Transmission and Detection**

**Laboratory Goals:**

* How to use a waveform for passband transmission?
* How to use orthogonal signals for modulation?
* What is the most common demodulator and detector?
* How does the noise impact the detection?

**Description:**

In this experiment, we study the transmission and detection of signals in the passband. Most of the laboratory content can be found in the MATLAB live script. This document gives a brief description about every section, then states the laboratory tasks.

1. Parameter initialization.
2. This shows the several types of modulation.
3. The Amplitude Shift Keying (ASK) is discussed here.
4. The received signal is decoded then detected. Two decoders are introduced.
5. The correlator decoder and detector are implemented.
6. The generation of noise and its impact are implemented and discussed.

**Tasks:**

1. Use these parameters for all the following tasks:
   1. Amplitude (): TUID(9) + 1 Volt
   2. Message frequency (): TUID(8) + 1 KHz
   3. Carrier frequency (): (TUID(7) + 20) \*
2. Find the appropriate thresholds for signal detection in 4-ASK.
3. Generate 1000 random samples for the 4-ASK and fill the following table

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

1. Design a 16-ASK system with these amplitudes and find the appropriate thresholds for signal detection in 16-ASK.

[-8, -7, -6, …, -1, 1, 2, …, 8] / 8

Then make the sinusoid waveform to send the message that contains your TUID digits in order. Put the corresponding plots and titles in your report.

1. Generate 1000 random samples for the 16-ASK and fill the same table in Task 2.
2. Compare Tables in task 2 and 4 and describe the observed differences in mean absolute error of 4-ASK and 16-ASK.
3. Plot the power spectrum of the baseband, carrier, modulated, and received signals for SNR = 0 dB.