Lab 7 – Project

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Prof. Dr. George Atia - Section 0012

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# **Experiment Objective**

Understand the principles of Binary Phase Shift Keying (BPSK) digital modulation scheme, its error performance through simulation and hardware implementation of BPSK modulation.

# **2.0 About Laboratory Day and Equipment List**

# The laboratory session took place on the Thursday section between 9:00am and 11:50am on March 28th, 2024. My lab partner was Isiah. The equipment for the is experiment is listed below,

1. MATLAB
2. Rohde & Schwarz RTM 3034 Oscilloscope
3. Function Generator
4. 2N4392 NMOS
5. LF351N Operational Amplifier

# **3.0 Simulation**

A graph with blue dots

Description automatically generated

Constellation Diagram of Input Message with Noise

A graph with blue dots

Description automatically generated

Constellation Diagram of Channel Effects

A grid with blue dots

Description automatically generated

Received Message with Channel Effects and Noise

# **3.0 MATLAB Code**

Used to generate figure(s)

clear all

close all

clc

A = sqrt(2);

data = zeros(1, 1e4);

qpsk\_symbols = [(1-1j), (1+1j), (-1-1j), (-1+1j)];

for i=1:1:length(data)

data(i) = A \* qpsk\_symbols(randi(length(qpsk\_symbols)));

end

plot(real(data), imag(data), '.');

grid on;

figure;

g = [1 0 0 0.65];

AWGN = awgn(data, 12, 2, 'dB');

ych = conv(data, g, 'same');

y = ych + AWGN;

plot(real(ych), imag(ych), '.');

grid on;

hold off;

figure

plot(real(y), imag(y), '.');

# **4.0 Learned Objectives**

* BPSK Modulation
* Channel Effects
* MATLAB Simulation

# **5.0 Conclusion**

In this lab we saw how we can modulate an m-array signal using QBSK, where we send the message using 4 symbols. In this 4-array scheme, we send the symbols with the same amplitude but with 4 equally spaced symbols. We saw the effects of channel which would make demodulation impossible unless we invert the channel effect. Also, we noticed that the noise (to a lesser extent) also affects reception of the signal. If the noise is lower, we can potentially have a higher m-array signal because there would a wider error margin. Overall, this lab helped form a better understanding of theoretical analysis of BPSK and general QAM siganls.