**Assignment 3**

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# Part One

## 1.1 Gram-Schmidt Orthogonalization

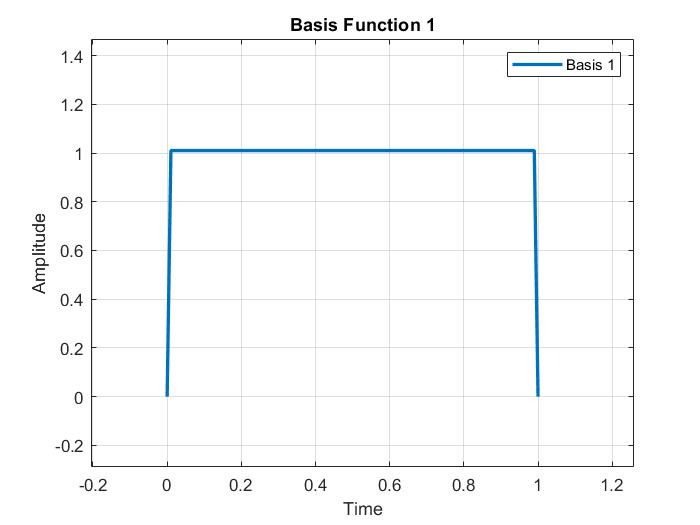


Figure Φ1 VS time after using the GM\_Bases function

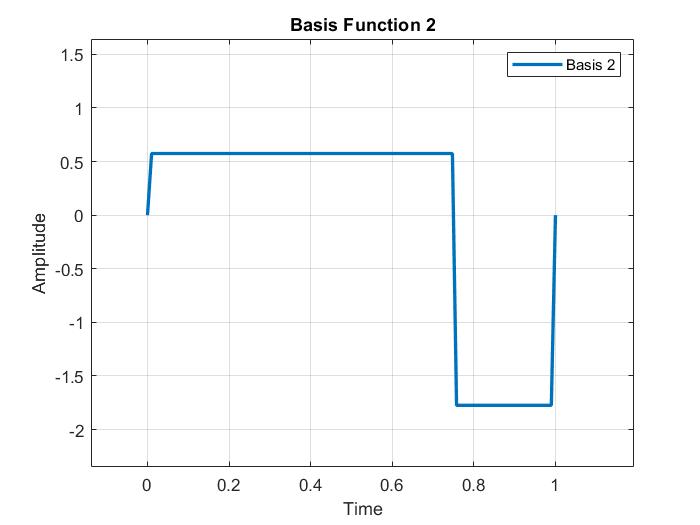


Figure Φ2 VS time after using the GM\_Bases function.

**Solution verification:**

So, the bases are orthogonal.

## 1.2 Signal Space Representation

Here we represent the signals using the base functions.

A picture containing text, line, plot, screenshot

Description automatically generated

Figure Signal Space representation of signals s1, s2

## 1.3 Signal Space Representation with adding AWGN

-the expected real points will be solid and the received will be hollow

**Case 1**:

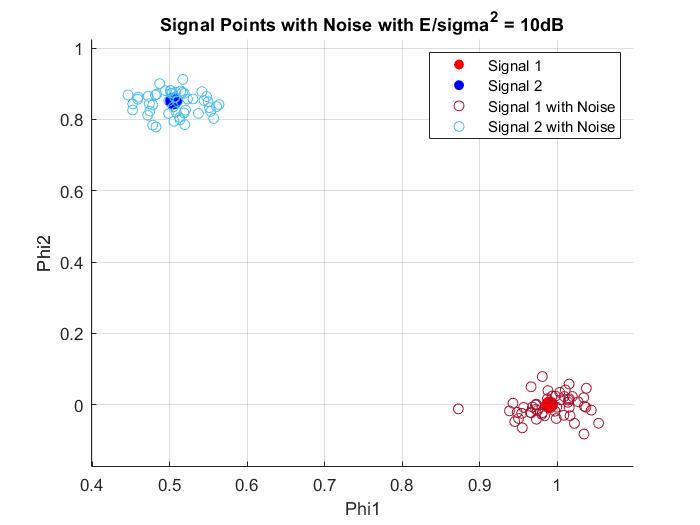


Figure Signal Space representation of signals s1, s2 with E/σ¬2 =10dB

**Case 2**:

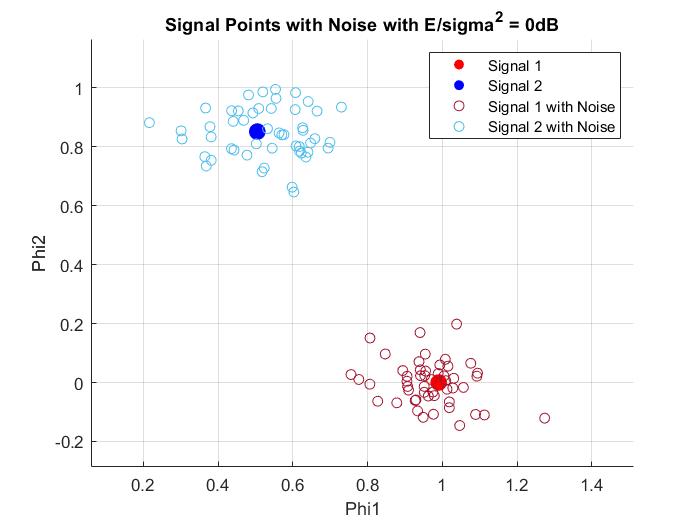


Figure Signal Space representation of signals s1,s2 with E/σ¬2 =0dB

**Case 3**:

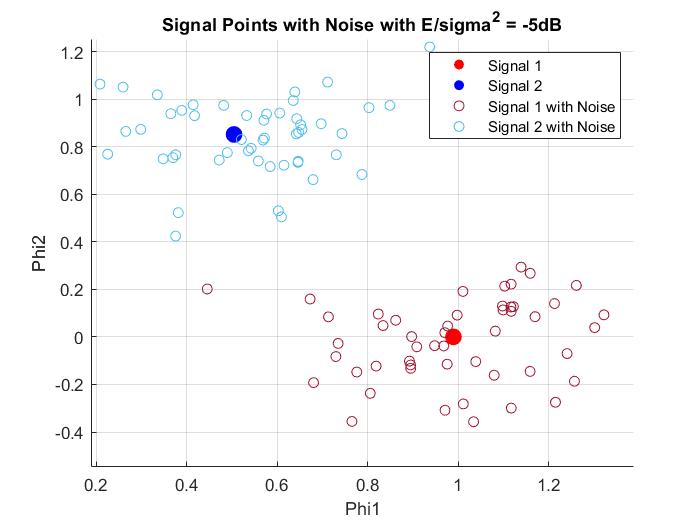
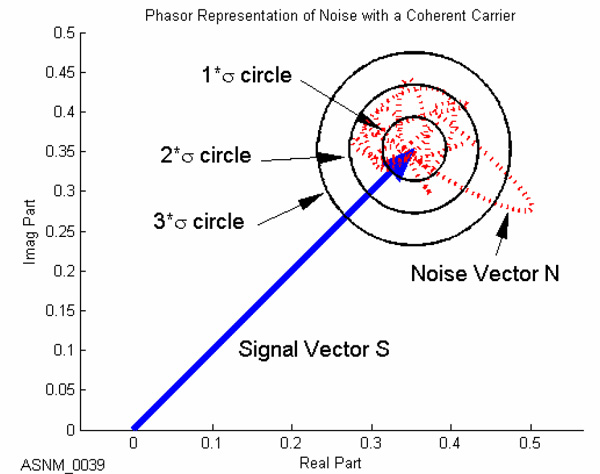


Figure Signal Space representation of signals s1, s2 with E/σ¬2 =-5dB

## 1.4 Noise Effect on Signal Space

How does the noise affect the signal space?

Receiver will get

Then we find

The receiver will get a signal yij whose space vector near to the space vector of Sij “the space vector of the sent pulse.”

Does the noise effect increase or decrease with increasing 𝜎2?

It’s noticed that with the increase of the variance of the noise, the signal to noise ratio decreases then the probability of error increases “the uncertainty increases” as observed from the following image.

# References

1. Matlab documentations for rectangularPulse function
2. [Wikipedia](https://en.wikipedia.org/wiki/Additive_white_Gaussian_noise#Effects_in_phasor_domain)

# Appendix A: Codes for Part One:

## A.1 Code for Gram-Schmidt Orthogonalization

## A.2 Code for Signal Space representation

## A.3 Code for plotting the bases functions

## A.4 Code for plotting the Signal space Representations

## A.5 Code for effect of noise on the Signal space Representations