Text

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**Laboratory Report**

Fall 2021

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| Laboratory Number: | **02** |
| Laboratory Title: | **Geometrical Representation** |
| Full Name: | **Robert Louis Bara** |
| TUID: | **915614617** |

**Description:**

This lab introduces the orthogonal function space and orthonormal basis of signals. By using my TUID, two signals will be generated, and their inner product is calculated to determine if they are orthogonal, meaning their inner product is 0. Signals with the same frequency are not orthogonal. The inner product can be defined as,

A signal is orthonormal if it is orthogonal and normalized, meaning their inner product with each other is 0, but with itself is 1, such as,

or

The energy of a signal can be determined by performing the inner product with itself. Signal Decomposition which depicts the project of a signal in every orthogonal dimension, can then be performed. Geometrical Representation depicts the projection of a signal in every dimension of to and is defined as,

To find the Orthogonal Basis function, the Gram-Schmidt algorithm can be applied which states,

Meaning the orthonormal functions can be defined as,

,

Where represents the energy of a signal, is the number of signals found by geometrical representation, and is defined as,

**Images:**

Chart

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Figure . Plotting the Orthonormal Basis of both signals

Chart, scatter chart

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Figure . Plotting the Constellation diagram of the two signals

**Descriptive Answers to Tasks:**

After defining the functions stated below, I used section 4’s code to plot the orthonormal basis of the two signals using the Gram-Schmidt Algorithm, as well as the constellation diagram. This section also allowed me to obtain the coefficients needed for the second half of the lab that will be done next lab.

**Code:**

**Section 01**

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

clc; clear; %TUID 915614617

A = 8; % Signal amplitude

rb = 2000; % (Fundamental) frequency of signal in KHz

Tunit = 1 / rb; % Period of signal

fs = 1000 \* rb; % Sampling frequency

Ts = 1 / fs; % Sampling period

**Functions Definition**

Half Pulse based upon TUID(7)=6:

function s = signal6(A, T, t) p(t)

t = mod(t, T);

s = 0 .\* t;

s(t <= T/2) = A; % Pulse when t<T/2

s(t > T/2 ) = 0; % Zero when t>T/2

end

Positive sinusoid, Negative Pulse based upon TUID(7)=6:

function s = signal7(A, T, t) q(t)

t = mod(t, T);

s = A \* sin(2 .\* pi .\* t / T); % Positive Pulse when t<T/2

s(t > T/2) = -A; % Negative Pulse when t>T/2

end