Text

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**Laboratory Report**

Fall 2021

|  |  |
| --- | --- |
| Laboratory Number: | **04** |
| Laboratory Title: | **Geometrical Representation Pt.2** |
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| TUID: | **915614617** |

**Description:**

Lab 4 continues last week's examination of the orthogonal function space and orthonormal basis of signals. Two signals were programmed last lab based upon my TUID, and their inner product determined orthogonality. Signals with an inner product equal to 0 and equal to one when performed with itself (also known as the energy of a signal), are orthonormal. The inner product is defined as,

Depicting the project of a signal in every orthogonal dimension is known as signal decomposition, while geometrical representation will depict the signal’s projection in every dimension of to , defined as,

The Orthogonal Basis function can be found using the Gram-Schmidt algorithm recursively on two signals, stating,

Meaning,

If and represents the energy of a signal and are the number of signals, then coefficients of the orthonormal function are defined as

Where,

, , ,

Therefore, orthonormal functions are defined as,

,

**Images:**

Chart, scatter chart

Description automatically generated

Figure . Constellation diagram for q(t), T1=2Tb, T2=3Tb

Chart, scatter chart

Description automatically generated

Figure . Constellation diagram p(t) & q(t), Tp=3Tb, Tq=2Tb

Chart, scatter chart

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Figure . Constellation diagram p(t), ϴ1=0, ϴ2=π/4

**Numerical Tables:**

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Just use | Use & | Just use |
|  | 0.2874 | 0.1916 | 0.0319 |
|  | 0.2874 | 0.2874 | 0.0319 |
|  | 0.0446 | -0.1483 | 0.75 |
|  | 0.5361 | 0.3477 | 0.1787 |
|  | 0 | 0 | 0 |
|  | 0.0239 | -0.0795 | 0.134 |
|  | 0.5356 | 0.5302 | 0.1182 |
|  | -1.1786e-08 | 2.2023e-09 | 4.4485e-07 |

**Descriptive Answers to Tasks:**

To fill in the table, columns 1 and 2 were obtained by running the sample live-script section 6, while the last column was obtained by running section 7. Sections 6 and 7 also generate the constellation diagrams based upon the signal space and orthonormal functions. For these tasks I implemented my signal using the drop-down menu and for the phase modulated signal, I multiplied by scalar or , to obtain a phase of .

**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 p(t) 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 q(t) 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