Text

Description automatically generated with medium confidenceDigital Communication Systems

**Laboratory Report**

Fall 2021

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| --- | --- |
| Laboratory Number: | **03** |
| Laboratory Title: | **Binary Basedband Coding** |
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| TUID: | **915614617** |

**Description:**

This lab explores Binary Baseband Coding by generating random binary sequences and encoding them using a technique determined by my TUID. My TUID determined I should encode the binary signal using Bipolar RZ and Differential NRZ methods. The Bipolar RZ encoding will have a fixed positive value for symbol 1 and an equivalent negative value for symbol 0. Since it is return to zero, that means the pulse should return to zero for a portion of the cycle, typically at about half of the period. Differential Unipolar NRZ inverts the symbols, meaning that symbol 0 is the last pule shape while symbol 1 is the last pulse shape inverted. Since the graph is unipolar, there will be a fixed positive value for symbol 1, while symbol 0 will be 0, and this encoding process does not return to 0, meaning that the pulses will last an entire period.

**Images:**

Chart, histogram

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Figure . Original Binary Values based upon my TUID's generated Signal, to be compared to encoding methods

Chart, histogram

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Figure . Bipolar RZ graph when n=10

Chart, histogram

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Figure . Differential Unipolar NRZ graph when n=10

Chart

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Figure . Spectrum Analysis of Bipolar RZ, when n=80

Zooming in, to determine the bandwidth and null bandwidth,

Chart, line chart

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Figure . Spectrum Analysis of Bipolar RZ, zoomed in, when n=80

A screenshot of a computer

Description automatically generated with medium confidenceFigure . Differential NRZ when n=4000

Zoomed in, to find bandwidth and null bandwidth,

Chart

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Figure . Spectrum Analyzer of Diff NRZ, when n=4000, zoomed in

**Numerical Tables:**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Parameter | Symbol Rate | Bit Rate | BW | Null BW |
| Encoding 1 | 2000Hz | 2000Hz | .195 | 0.38 |
| Encoding 2 | 2000Hz | 2000Hz | 0.062 | 0.13 |

**Code:**

**Section 01**

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

%TUID 915614617

clc; clear;

A = 8; % Signal amplitude

rb = 2000; % Fundamental frequency of signal

Tb = 1 / rb; % Period of signal

fs = 100 \* rb; % Sampling frequency

Ts = 1 / fs; % Sampling period

% Bipolar RZ

bnrz = 2 \* (binary - 0.5);

signal\_brz = A\*repelem(bnrz, floor((Tb/2)/Ts)); % Change indices to the new sampling frequency

t=(0:length(signal\_brz)-1)\*Ts;

plot(t, signal\_brz); xlim([0, t(end)+t(1)]); ylim([-A-0.1, A+0.1]); title('Bipolar RZ');

% Differential (Unipolar) NRZ

t = (0:length(signal)-1)\*Ts; % New sample time

dunrz = zeros(size(binary));

dunrz(1) = binary(1);

for c = 2:length(binary)

dunrz(c) = xor(dunrz(c-1), binary(c));

end

signal\_dunrz = A\*repelem(dunrz, floor(Tb/Ts)); % Change indices to the new sampling frequency

plot(t, signal\_dunrz); xlim([0, t(end)+t(1)]); ylim([-0.1, A+0.1]); title('Differential Unipolar NRZ');

For Spectrum Analyzer, n=80

% Bipolar RZ

scope1 = dsp.SpectrumAnalyzer();

scope1.SampleRate = fs;

scope1.PlotAsTwoSidedSpectrum = false;

scope1.SpectrumUnits = "dBW";

scope1(signal\_brz');

scope1.Name = 'Bipolar RZ';

release(scope1)

% Diff NRZ

scope2 = dsp.SpectrumAnalyzer();

scope2.SampleRate = fs;

scope2.PlotAsTwoSidedSpectrum = false;

scope2.SpectrumUnits = "dBW";

scope2(dunrz');

scope2.Name = "Differential Unipolar NRZ";

release(scope2);