A blue circle with text and symbols

Description automatically generated

**AMERICAN INTERNATIONAL UNIVERSITY–BANGLADESH (AIUB)**

FACULTY OF ENGINEERING

Course name: Data Communication

Course code: COE 3201

Section: H

Semester: Spring 2023-24

Name: MD. ABU TOWSIF

ID: 22-47019-1

Instructor name: Dr. Muhammad Morshed Alam

Experiment no: 04

Experiment name: Study of Nyquist bit rate and Shannon capacity using MATLAB

Submission date: March 03rd, 2024

**Performance Task for Lab Report: ( ID = AB-CDEFG-H)**

ID: AB-CDEFG-H

Performance Task for Lab Report 04: (your ID = AB-CDEFG-H)

\*\*Generate a composite signal using two simple signals as,

x = A1 sin(2π(C\*100)t ) + A2 cos(2π(G\*100)t) + s\*randn(size(t));

(a) Select the value of the amplitudes as follows: let A1 = AB, A2 = AF and s=AH

(b) Calculate the SNR value of the composite signal.

(c) Find the bandwidth of the signal and calculate the maximum capacity of the channel.

(d) What will be the signal level to achieve the data rate?

**ANSWER:**

1. Select the value of the amplitudes as follows: let A1 = AB, A2 = AF and s=AH

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A | B | - | C | D | E | F | G | - | H |
| 2 | 2 | - | 4 | 7 | 0 | 1 | 9 | - | 1 |

My id:

ID = 22-47019-1

C = 4;

G = 9;

A1 = AB = 22;

A2 = AF = 21;

s = AH = 21;

So,

x = A1 sin(2π(C\*100)t ) + A2 cos(2π(G\*100)t) + s\*randn(size(t));

//MATLAB code where all the parameters are defined

%{

ID: 22-47019-1 (AB-CDEFG-H)

SO, C = 4;

G = 9;

A1 = AB = 22;

A2 = AF = 21;

s = AH = 21;

%}

C = 4;

G = 9;

A1 = 22;

A2 = 21;

s = 21;

fs = 4000; % Sampling frequency

t = 0:1/fs:1-1/fs; % Time duration

x = A1\*sin(2 \* pi \* (C\*100) \* t ) + A2\*cos(2\*pi\*(G\*100) \* t) + s\*randn(size(t)); %composite signal

1. Calculate the SNR value of the composite signal.

|  |  |
| --- | --- |
| MATLAB Code | Output Figure |
| %{  ID: 22-47019-1 (AB-CDEFG-H)  SO, C = 4;  G = 9;  A1 = AB = 22;  A2 = AF = 21;  s = AH = 21;  %}  C = 4;  G = 9;  A1 = 22;  A2 = 21;  s = 21;  fs = 4000; % Sampling frequency  t = 0:1/fs:1-1/fs; % Time duration  x = A1\*sin(2 \* pi \* (C\*100) \* t ) + A2\*cos(2\*pi\*(G\*100) \* t) + s\*randn(size(t)); %composite signal    powfund = A1^2/2 + A2^2/2;  varnoise = s^2;  %noise  noise = s\*randn(size(x));    %noisy signal  noisySignal = x + noise;  SNR = snr(noisySignal) %Calculation of SNR using snr function | Command window screenshot. |

(c) Find the bandwidth of the signal and calculate the maximum capacity of the channel.

|  |  |
| --- | --- |
| MATLAB Code | Output Figure |
| %{  ID: 22-47019-1 (AB-CDEFG-H)  SO, C = 4;  G = 9;  A1 = AB = 22;  A2 = AF = 21;  s = AH = 21;  %}  C = 4;  G = 9;  A1 = 22;  A2 = 21;  s = 21;  fs = 4000; % Sampling frequency  t = 0:1/fs:1-1/fs; % Time duration  x = A1\*sin(2 \* pi \* (C\*100) \* t ) + A2\*cos(2\*pi\*(G\*100) \* t) + s\*randn(size(t)); %composite signal    powfund = A1^2/2 + A2^2/2;  varnoise = s^2;  %noise  noise = s\*randn(size(x));    %noisy signal  noisySignal = x + noise;  SNR = snr(noisySignal); %calculating the SNR using the snr function    bandwidth = obw(x,fs) % Bandwidth of the signal  C = bandwidth \* log2(1+SNR) % Capacity of the channel |  |

(d) What will be the signal level to achieve the data rate?

|  |  |
| --- | --- |
| MATLAB Code | Output Figure |
| %{  ID: 22-47019-1 (AB-CDEFG-H)  SO, C = 4;  G = 9;  A1 = AB = 22;  A2 = AF = 21;  s = AH = 21;  %}  C = 4;  G = 9;  A1 = 22;  A2 = 21;  s = 21;  fs = 4000; % Sampling frequency  t = 0:1/fs:1-1/fs; % Time duration  x = A1\*sin(2 \* pi \* (C\*100) \* t ) + A2\*cos(2\*pi\*(G\*100) \* t) + s\*randn(size(t)); %composite signal      bandwidth = obw(x,fs); % Bandwidth of the signal  L=2; % Level of the signal  BitRate = 2\*bandwidth\*log2(L)  L = 2.^(BitRate/(2\*bandwidth)) %Signal level to achieve data rate |  |