Lab Report On

Wireless and Mobile Communication

Submitted To	**Submitted By**
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Problem No: 01

Problem statement:

Find the fading profile for a rayleigh channel with given parameters

Code:

```
clc;
clear all;
close all;
c = rayleighchan(1/50000, 200)
x = 7i*ones(3000,1);
y = filter(c,x);
plot(20*log10(abs(y))), title( "Mujahid 11609026" )
```

Output:

c =

ChannelType: 'Rayleigh'

InputSamplePeriod: 2.0000e-05

DopplerSpectrum: [1×1 doppler.jakes]

MaxDopplerShift: 200

PathDelays: 0

AvgPathGaindB: 0

NormalizePathGains: 1

StoreHistory: 0

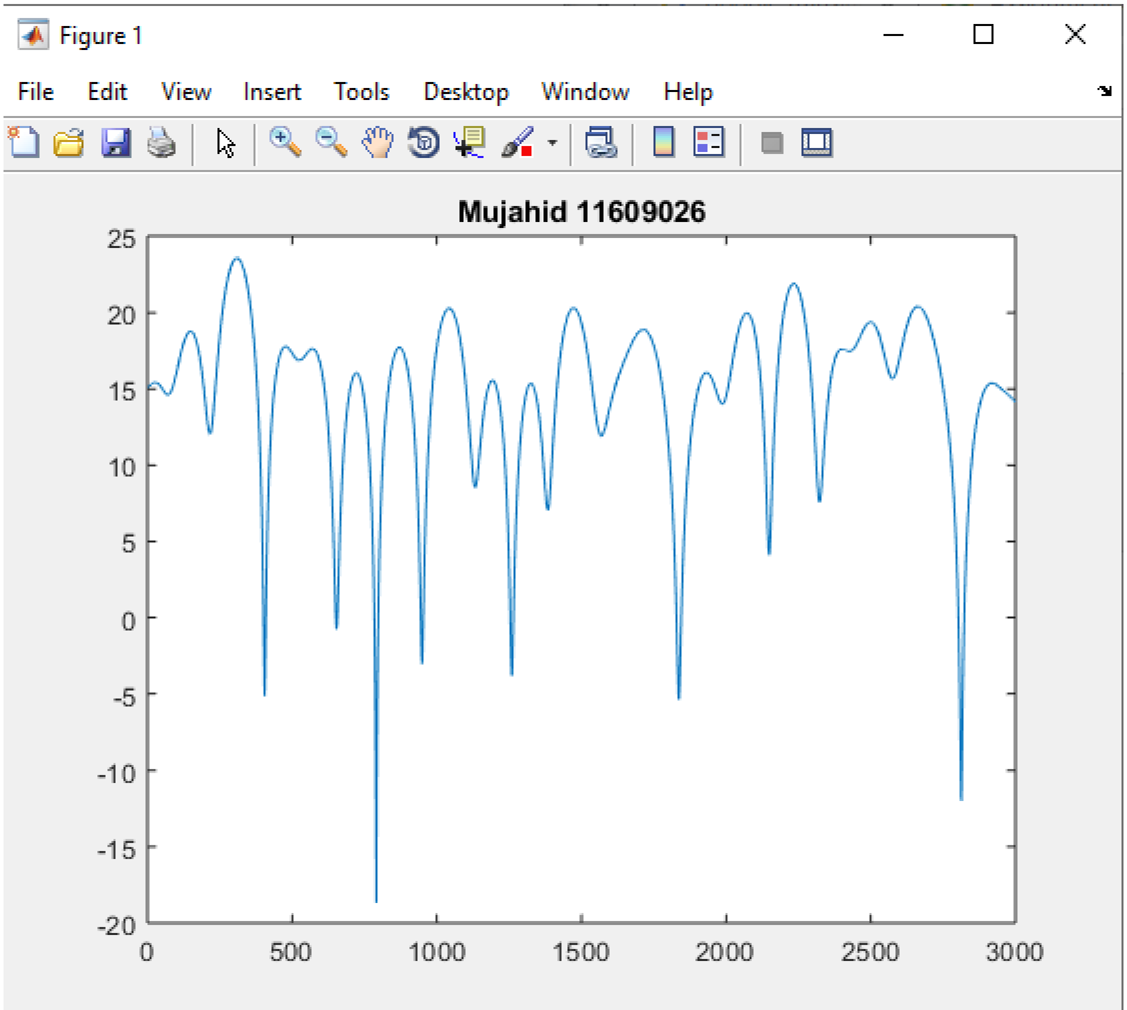
StorePathGains: 0

PathGains: -0.2271 - 0.2423i

ChannelFilterDelay: 0

ResetBeforeFiltering: 1

NumSamplesProcessed: 0



Discussion:

Rayleigh fading is caused by multipath reception. The mobile antenna receives a large number, say *N*, reflected and scattered waves. Because of wave cancellation effects, the instantaneous received power seen by a moving antenna becomes a random variable, dependent on the location of the antenna. A sample of a Rayleigh fading signal. Signal amplitude (in dB) versus time for an antenna moving at constant velocity. Notice the deep fades that occur occasionally. Although fading is a random process, deep fades have a tendency to occur approximately every half a wavelength of motion.

In the above code, in the Rayleighchan(ts,fd) function we use two parameters where constructs a frequency-flat ("single path") Rayleigh fading channel object. ts is the sample time of the input signal. Then we can model the effect of the channel on a signal x by using the syntax y = filter(c,x).

Thus we get the fading profile of rayleight channel.

Problem No: 02

Problem statement:

Find the fading profile for a rician channel with given parameters

Code:

```
clc ;
clear all ;
close all ;
c = ricianchan(1/50000, 200, 2)
x = 7i*ones(3000,1);
y = filter(c,x);
plot(20*log10(abs(y))),title( "Mujahid 11609026" )
```

Output:

c =

ChannelType: 'Rician'

InputSamplePeriod: 2.0000e-05

DopplerSpectrum: [1×1 doppler.jakes]

MaxDopplerShift: 200

PathDelays: 0

AvgPathGaindB: 0

KFactor: 2

DirectPathDopplerShift: 0

DirectPathInitPhase: 0

NormalizePathGains: 1

StoreHistory: 0

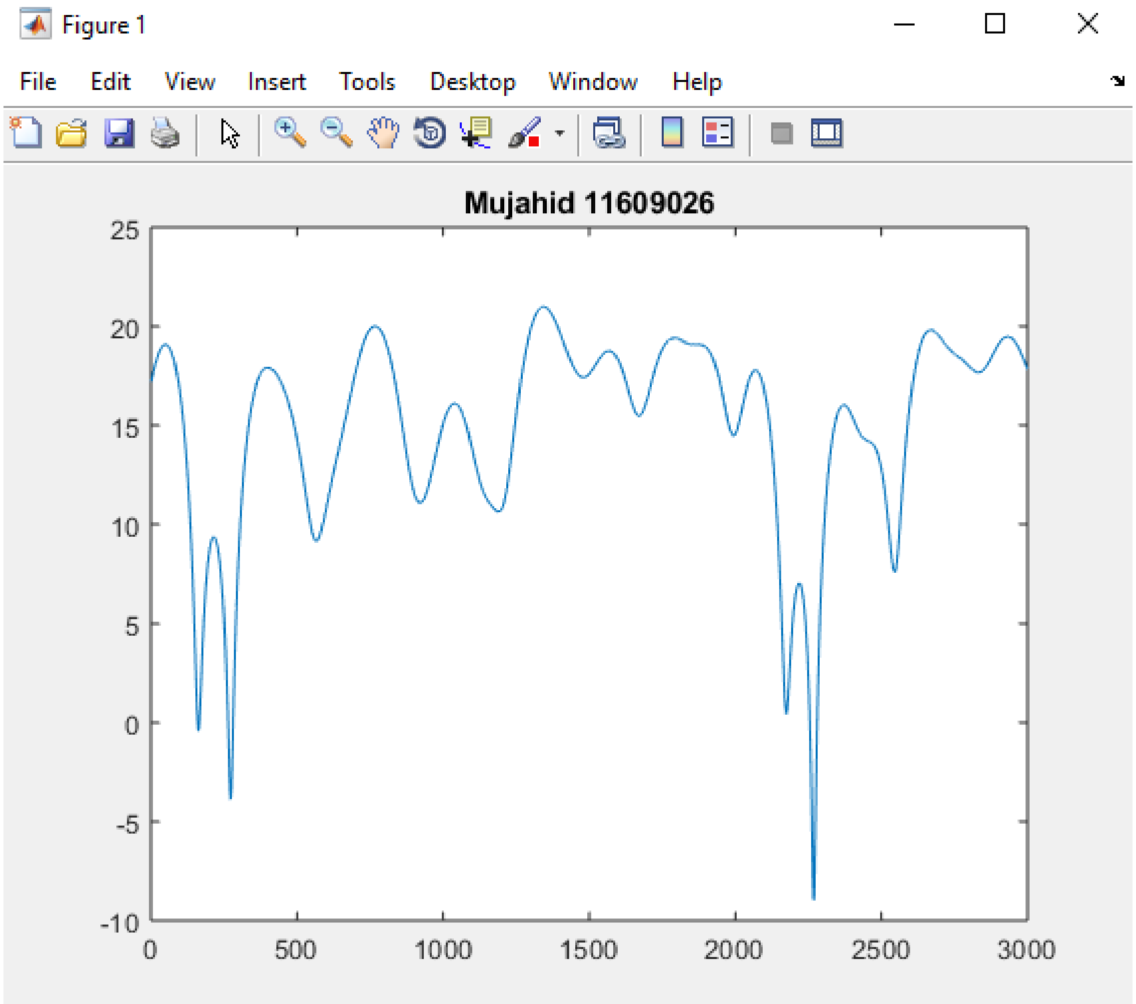
StorePathGains: 0

PathGains: 1.0482 - 0.5366i

ChannelFilterDelay: 0

ResetBeforeFiltering: 1

NumSamplesProcessed: 0



Discussion:

The model behind Rician fading is similar to that for Rayleigh fading except that in Rician fading a strong dominant component is present. This dominant component can for instance be the line-of-sight wave. Refined Rician models also consider that the dominant wave can be a phasor sum of two or more dominant signals line-of-sight, plus a ground reflection. And the dominant wave can also be subject to shadow attenuation. This is a popular assumption in the modelling of satellite channels. Besides the dominant component, the mobile antenna receives a large number of reflected and scattered waves.
In the above code, c = ricianchan(ts,fd,k) constructs a frequency-flat (single path) Rician fading-channel object. ts is the sample time of the input signal, in seconds. fd is the maximum Doppler shift, in hertz. k is the Rician K-factor in linear scale. You can model the effect of the channel chan on a signal x by using the syntax y = filter(c,x).

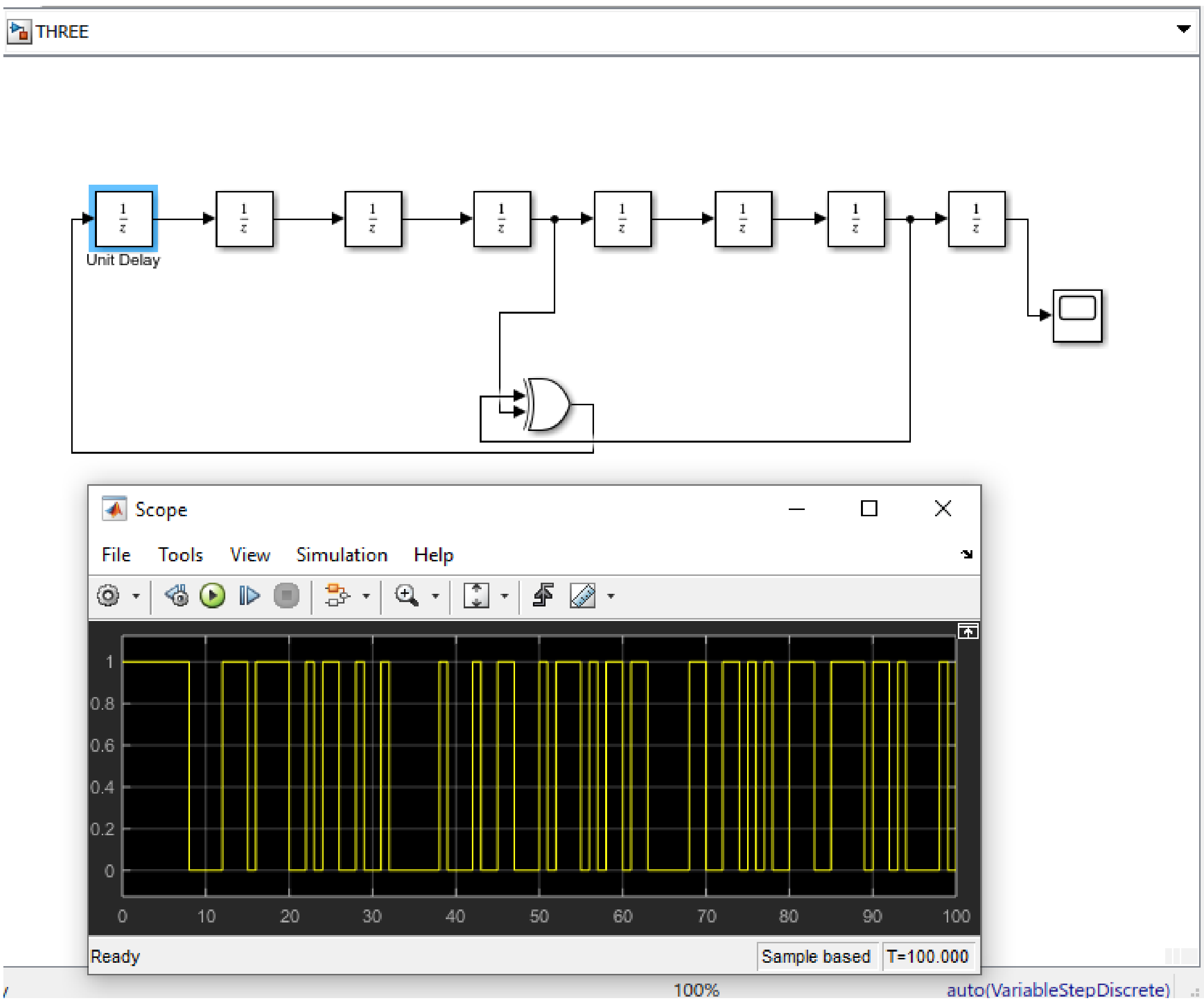
Thus we get the fading profile of Rician channel.

Problem No: 03

Problem statement:

Construct a pn sequence generator for given function

Structure & Output:



Discussion:

For the given generator polynomial, the model generates a PN sequence of period 100, by using the PN Sequence Generator block and by modeling a LFSR using primitive Simulink blocks.The two parameters, Initial states and Output mask vector (or scalarshift value), are interpreted in the LFSR model schematic.

Using the PN Sequence Generator block allows you to easily generate PN sequences of large periods. To experiment further, open the model. Modify settings to see how the performance varies for different path delays or adjust the PN sequence generator parameters. You can experiment with different initial states, by changing the value of Initial states prior to running the simulation. For all values, the two generated sequences are the same.

Synchronization Codes

Use the comm.BarketCode System object and BarketCode Generator block to generate Barker codes to perform synchronization. Barker codes are subsets of PN sequences. They are short codes, with a length at most 13, which are low-correlation sidelobes. A correlation sidelobe is the correlation of a codeword with a time-shifted version of itself.

Orthogonal Codes

Orthogonal codes are used for spreading to benefit from their perfect correlation properties. When used in multi-user spread spectrum systems, where the receiver is perfectly synchronized with the transmitter, the despreading operation is ideal.

Problem No: 04

Problem statement:

Generate 8 bit walsh code using walsh hadamard matrix.

Code:

```
clc;
clear all;
close all;
W=[-1];
for k=1:3
W = [W W; W -W];
end
for j = 1:8
code = W(j, 1:8)
end;
```

Output:

```
code = -1   -1   -1   -1   -1   -1   -1   -1

code = -1    1   -1    1   -1    1   -1    1

code = -1   -1    1    1   -1   -1    1    1

code = -1    1    1   -1   -1    1    1   -1

code = -1   -1   -1   -1    1    1    1    1

code = -1    1   -1    1    1   -1    1   -1

code = -1   -1    1    1    1    1   -1   -1

code = -1    1    1   -1    1   -1   -1    1
```

Discussion:

Walsh Hadamard matrix is a specific square matrix of dimensions 2^n, where n is some particular natural number. The entries of the matrix are either +1 or −1 and its rows as well as columns are orthogonal, i.e. dot product is zero.

Walsh Hadamard matrix is both symmetric and orthogonal, means $H^T = H$.

Basic rules is $W_1 = [-1]$ and then $W_{2N} = [\ W_N\ W_{N;}\ W_N\ \overline{W_N}\ ]$.

Problem No: 05

Problem statement:

Determine the freespace loss and the power received using Matlab program.

Code:

```
clc;
close all;
clear all;
f=input('enter the frequency in Mhz: ');
L=300/f;
disp('thus the wavelength is: ');
L
d=input('enter the distance in km: ');
Gt=input('enter the transmitting antenna gain in db: ');
Gr=input('enter the receiving antenna gain in db: ');
Wt=input('enter the transmitted power in db: ');
ls=32.44+20*log10(d)+20*log10(f);
disp(sprintf('%s %d %s','the path loss is:',ls,'db'));
Wr=Wt+Gt+Gr-ls;
disp(sprintf('%s %d %s','the recieved power is:',Wr,'db'));
wr=10^(Wr/10);
disp(sprintf('%s %d %s','the recieved power is:',wr,'watts'));
```

Output:

enter the frequency in Mhz: 5

thus the wavelength is: L = 60

enter the distance in km: 10

enter the transmitting antenna gain in db: 15

enter the receiving antenna gain in db: 20

enter the transmitted power in db: 14

the path loss is: 6.641940e+01 db

the recieved power is: -1.741940e+01 db

the recieved power is: 1.811590e-02 watts

Discussion:

In telecommunication, the free-space path loss is the attenuation of radio energy between the feedpoints of two antennas that results from the combination of the receiving antenna's capture area plus the obstacle-free, line-of-sight path through free space. For determining the freespace loss and the power received in the above code we need the the wavelength and we can also get the wavelength by the frequency. Then from the distance, transmitting and receiving antenna gain and transmitted power we achieved the path loss. Finally removing the path loss from the actual gain we get the actual received power.

Problem No: 06

Problem statement:

Write a Matlab program to calculate the median path loss for Okumura model for outdoor propagation.

Code:

```
clc;
clear all;
close all;
Lfsl=input('enter the free space loss:');
Amu=input('enter the median attenuation value:');
Hmg=input('enter the Mobile station antenna height gain factor:');
Hbg=input('enter the Base station antenna height gain factor:');
Kc=input('enter the Correction factor gain:');
L=Lfsl+Amu-Hmg-Hbg-Kc;
disp(sprintf('%s %f %s','the median path loss:',L,'dB'));
```

Output:

enter the free space loss:10

enter the median attenuation value:5

enter the Mobile station antenna height gain factor:2

enter the Base station antenna height gain factor:3

enter the Correction factor gain:1.5

the median path loss: 8.500000 dB

Discussion:

This model is used for finding out Path Loss in the frequency range of 150MHz to 1920 MHz (typically extended up to 3 GHz) for distances of 1 to 100 Km & base station antenna heights ranging from 30m to 100 m. Approximations have taken from this model for transmitter antenna height of 3 m & distance below 1 Km. Okumura model is wholly based on measured data.

For getting the path loss in Okumura model we need to add free space loss and median attenuation and subtract the value of Mobile station and Base station antenna height gain factor as well as Correction factor gain.