WMC LAB EXPERIMENT 6

NAME: RAHIL SHARMA

PRN: 18070123062

BATCH: EA-3;G2

AIM: To Simulate the Friss Free Space Propagation Model

THEORY: t is used to predict the path loss when there is a clear unobstructed LOS between the transmitter and the receiver. It is based on the inverse square law of distance which states that the received power (Pr) decays by a factor of square of the distance (d) from the transmitter.

Pr is inversely propotional to d^2

The receiver power is obtained by the following equation:

Pr(d) = (Pt*Gt*Gr*lamda^2)/(4*pi*D)^2*L

Pr(d)=Received signal power in Watts expressed as a function of separation –d meters between the transmitter & receiver Pt= Power at which the signal was transmittedin WattsGt,Gr= Gains of transmitter & receiver antennas respectively λ= Wavelength of transmission in meters. L = Other Losses that is not associated with propagation loss. It includes system losses like loss at the antenna, transmission line attenuation, loss at various filters etc. The factor is usually greater than or equal to 1. If there are no such system losses L=1.Friis Free space equation is valid only in the far field region of the transmitting antenna.

Code and Output:

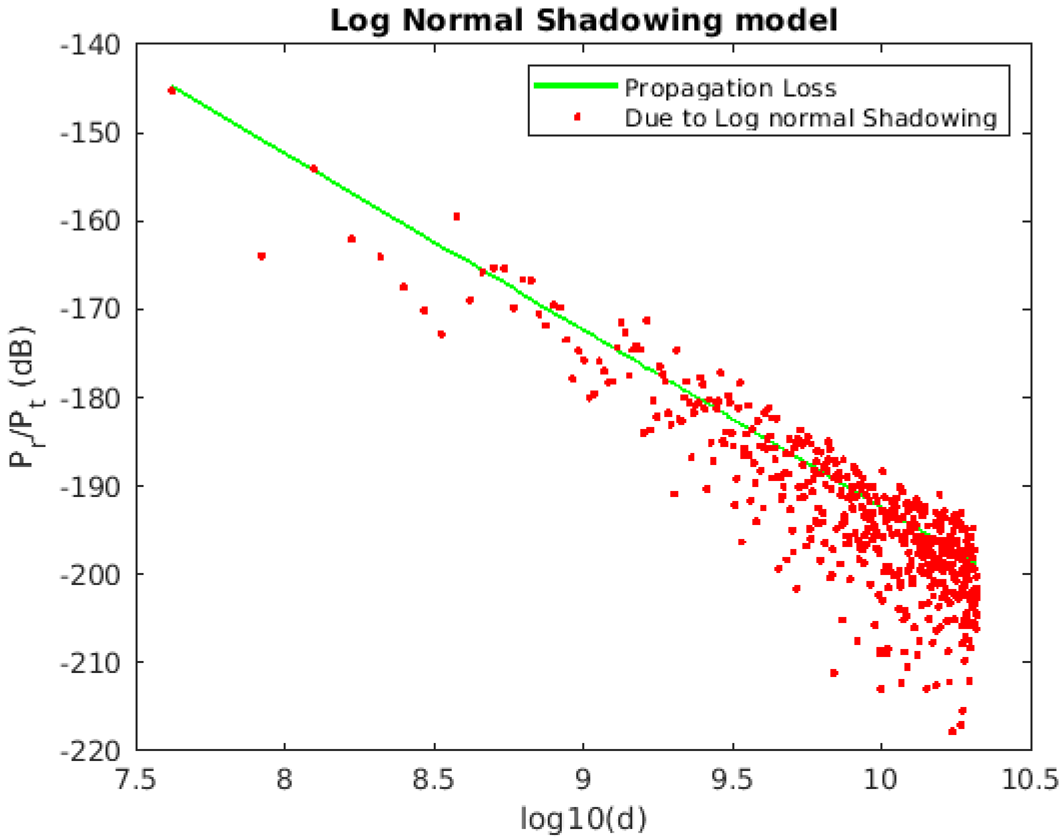
1. **Inclusing Shadowing effect**

```
%Matlab code to simulate Log distance/Log Normal Shadowing Path Loss model

%-----------Input section------------------------

PtdBm=52; %Input – Transmitted power in dBm

GtdBi=25; %Gain of the Transmitted antenna in dBi

GrdBi=15; %Gain of the Receiver antenna in dBi

frequency=1*10^9; %Transmitted signal frequency in Hertz
```

```
%Example Frequency = 1 GHz

d = 41935000*(1:1:500) ; %Array of input distances in meters

L=1; %Other System Losses, No Loss case L=1

sigma = 1; %Standard deviation of zero-mean Normal distribution

%-----------------------------------------------------

%Convert all powers to linear scale

Pt=10^((PtdBm-30)/10); %Convert to Watts

Gt=10^(GtdBi/10);

Gr=10^(GrdBi/10);

lambda=3*10^8/frequency; %Wavelength in meters

Pr= Pt*(Gt*Gr*lambda^2)./((4*pi.*d).^2*L);

X = sigma*randn(size(Pr));

propLoss = Pr./Pt;

PLdBm = 10*log10(propLoss)+10*log10(X);

PrdBm=10*log10(Pr)+30; %Convert to dBm

plot(log10(d),10*log10(propLoss),'G','LineWidth',2);

title('Log Normal Shadowing model')

xlabel('log10(d)');

ylabel('P_r/P_t (dB)');

hold on;

plot(log10(d),PLdBm,'r.');
```

```
Warning: Imaginary parts of complex X and/or Y arguments ignored.
```

```
legend('Propagation Loss','Due to Log normal Shadowing');
```

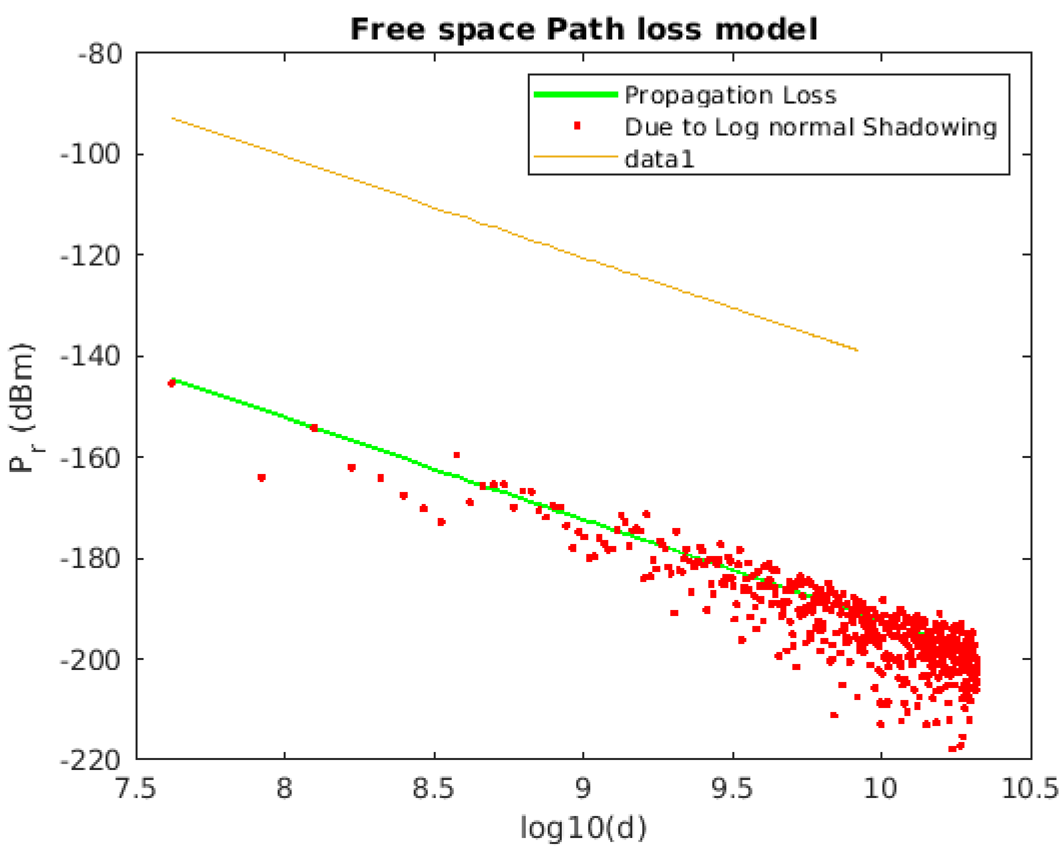


Log distance path loss model is a generic model and an extension to Friis Free space model. It is used to predict the propagation loss for a wide range of environments, whereas, the Friis Free space model is restricted to unobstructed clear path between the transmitter & the receiver.

2. Without Shadowing:

```
%Matlab code to simulate Friis Free space equation

%-----------Input section------------------------

PtdBm=52; %Input – Transmitted power in dBm

GtdBi=25; %Gain of the Transmitted antenna in dBi

GrdBi=15; %Gain of the Receiver antenna in dBi

frequency=1*10^9; %Transmitted signal frequency in Hertz

%Example Frequency = 1 GHz

d =41935000*(1:1:200) ; %Array of input distances in meters
```

```
L=1; %Other System Losses, No Loss case L=1

%---------------------------------------------------

%Convert all powers to linear scale

Pt=10^((PtdBm-30)/10); %Convert to Watts

Gt=10^(GtdBi/10);

Gr=10^(GrdBi/10);

lambda=3*10^8/frequency; %Wavelength in meters

Pr= Pt*(Gt*Gr*lambda^2)./((4*pi.*d).^2*L);

PrdBm=10*log10(Pr)+30; %Convert to dBm

plot(log10(d),PrdBm);

title('Free space Path loss model')

xlabel('log10(d)');

ylabel('P_r (dBm)');
```



Friis Free space equation is valid only in the far field region of the transmitting antenna.

Conclusion: From this experiment we learnt how to Simulate the Friss Free Space Propagation Model.