

Experiment - 7

Hata-Okumura Models

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Theory: The Okumura model is a radio propagation model that was built using the data collected in the city of Tokyo, Japan. The model is ideal for using in cities with many urban structures but not many tall blocking structures. The model served as a base for the Hata model.

Okumura model was built into three modes. The ones for urban, suburban and open areas. The model for urban areas was built first and used as the base for others.

```
% Matlab code to simulate Hata-Okumura Models
clc;
clear all;

%-----Input Section-----

Hbts= 50 ; % Height measured from the base of the BTS tower to the radiationcenterline

Tbts = 350 ; % Terrain elevation at the location of the BTS

Htav= 300; % Height of the average terrain (from 3 Km to 15 km distance from theBTS)

Hm=3 ; % Height of the mobile antenna in meters

f=870 ;% 100:100:3000; %Range of frequencies in MHz

d=3:3:15; % Range of Tx-Rx separation distances in Kilometers

Pt = 19.5; % Power transmitted by the BTS antenna in Watts

Gt= 10; % BTS antenna gain in dBi

%-----

Hb=Hbts+Tbts-Htav ;% Effective Height of the BTS antenna in meters

%Cell array to store various model names

models = {'Big City (Urban model)'; 'Small & Medium City (Urban model)';
'Sub-urban environment'; 'Open Rural environment'};
```

```
display('Hata-Okumura Model');
```

Hata-Okumura Model

```
display(['1 ' models{1,1}]);
```

1 Big City (Urban model)

```
display(['2 ' models{2,1}]);
```

2 Small & Medium City (Urban model)

```
display(['3 ' models{3,1}]);
```

3 Sub-urban environment

```
display(['4 ' models{4,1}]);
```

4 Open Rural environment

```
reply = input('Select Your choice of environment : ','s');
```

```
if 0<str2num(reply)<4
```

```
modelName = models{str2num(reply),1};
```

```
display(['Chosen Model : ' modelName])
```

```
else
```

```
error('Invalid Selection');
```

```
end
```

Chosen Model : Big City (Urban model)

```
switch reply
```

```
case '1',
```

```
C=0;
```

```
if f<=200
```

```
aHm=8.29*(log10(1.54*Hm))^2-1.1;
```

```
else
```

```
aHm=3.2*(log10(11.75*Hm))^2-4.97;
```

```

end

case '2',

C=0;

aHm = (1.1*log10(f)-0.7)*Hm-(1.56*log10(f)-0.8);

case '3',

aHm = (1.1*log10(f)-0.7)*Hm-(1.56*log10(f)-0.8);

C=-2*(log10(f/28))^2-5.4;

case '4',

aHm = (1.1*log10(f)-0.7)*Hm-(1.56*log10(f)-0.8);

C=-4.78*(log10(f))^2+18.33*log10(f)-40.98;

otherwise ,
error('Invalid model selection');
end

A = 69.55 + 26.16*log10(f) - 13.82*log10(Hb)-aHm;

B = 44.9 - 6.55*log10(Hb);

PL=A+B*log10(d)+C;
subplot(2,1,1)
plot(d,PL,'r','LineWidth',2);
title(['Hata-Okumura Path Loss Model for : ' modelName]);
xlabel('Distance - Kilometers');
ylabel('Path Loss (dB)');
%Compute Received Signal Level
Pr = 10*log10(Pt*1000)+Gt-PL

Pr = 1×5
    -78.3901    -87.9628    -93.5625    -97.5356   -100.6173

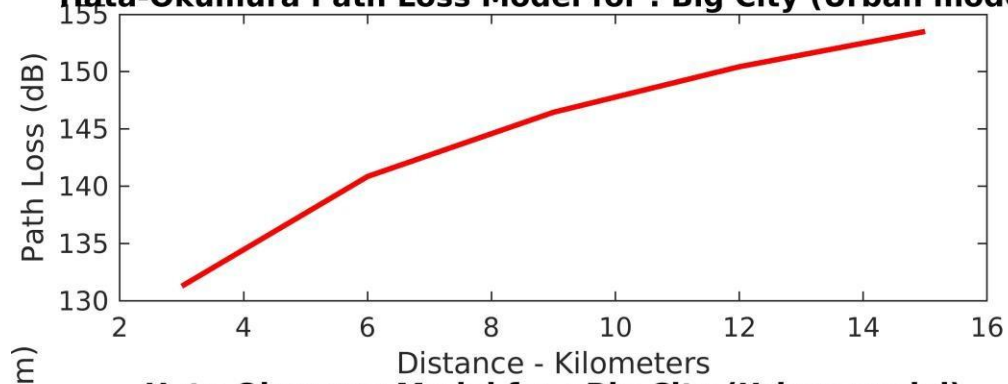
```

```

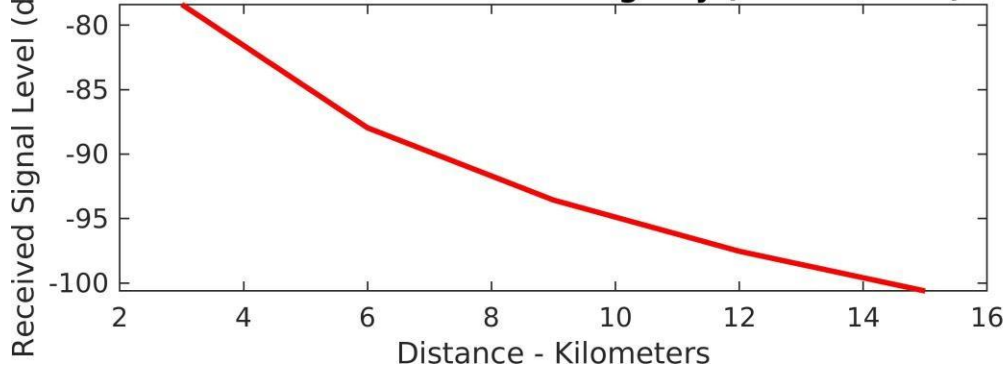
subplot(2,1,2)
plot(d,Pr,'r','LineWidth',2);
title(['Hata-Okumura Model for : ' modelName]);
xlabel('Distance - Kilometers');
ylabel('Received Signal Level (dBm)');

```

Hata-Okumura Path Loss Model for : Big City (Urban model)



Hata-Okumura Model for : Big City (Urban model)



HataOkumura_Model

Hata-Okumura Model

1 Big City (Urban model)

2 Small & Medium City (Urban model)

3 Sub-urban environment

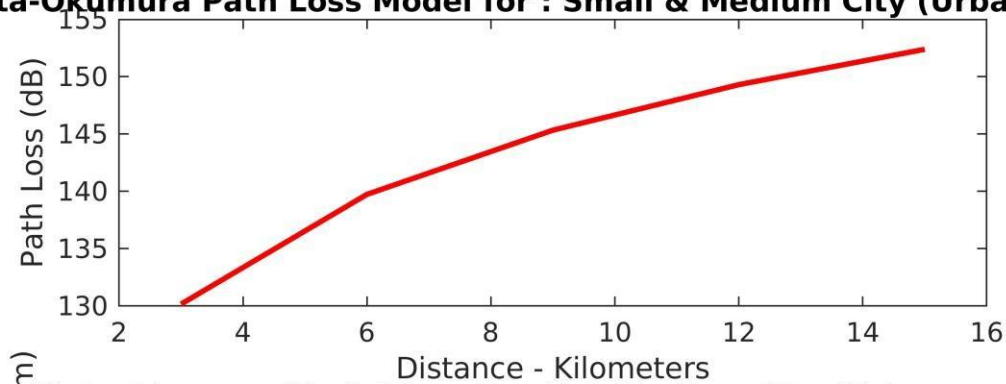
4 Open Rural environment

Chosen Model : Small & Medium City (Urban model)

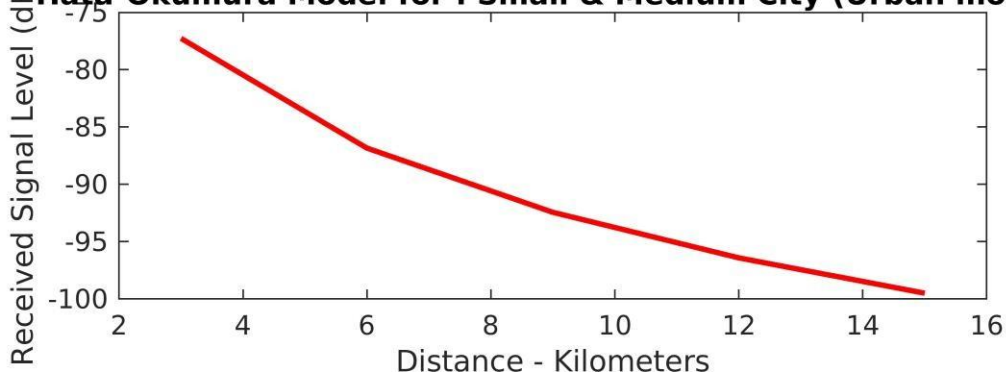
Pr = 1×5

-77.2652 -86.8379 -92.4376 -96.4107 -99.4924

Hata-Okumura Path Loss Model for : Small & Medium City (Urban model)



Hata-Okumura Model for : Small & Medium City (Urban model)



HataOkumura_Model

Hata-Okumura Model

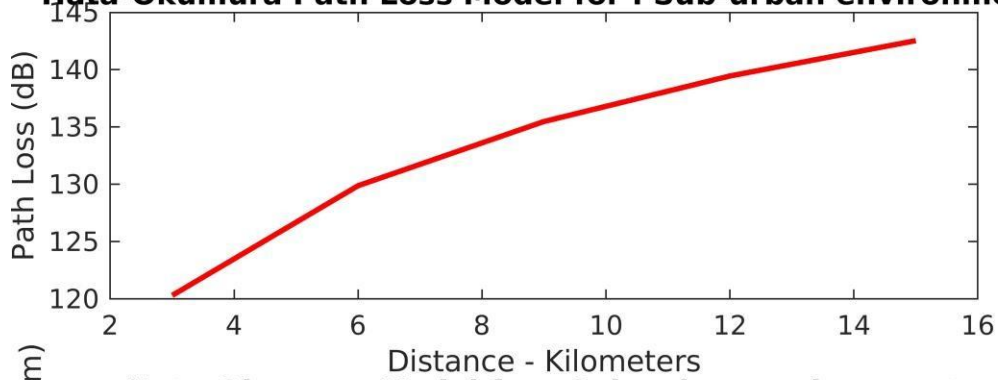
- 1 Big City (Urban model)
- 2 Small & Medium City (Urban model)
- 3 Sub-urban environment
- 4 Open Rural environment

Chosen Model : Sub-urban environment

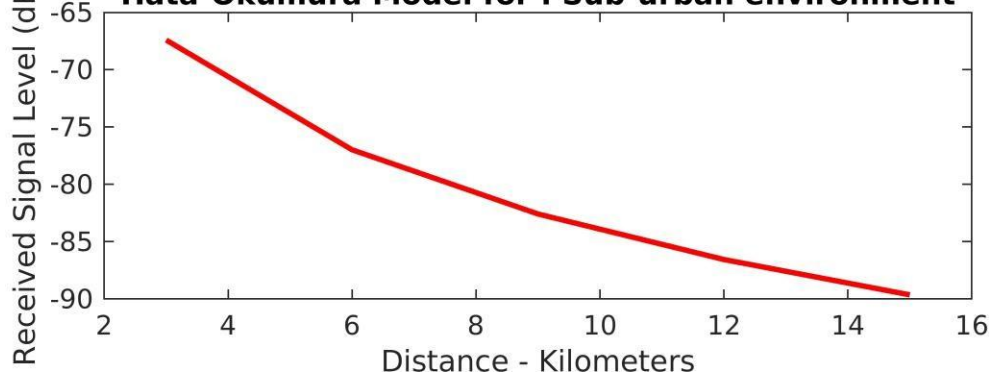
Pr = 1×5

-67.4109 -76.9836 -82.5833 -86.5564 -89.6381

Hata-Okumura Path Loss Model for : Sub-urban environment



Hata-Okumura Model for : Sub-urban environment



HataOkumura_Model

Hata-Okumura Model

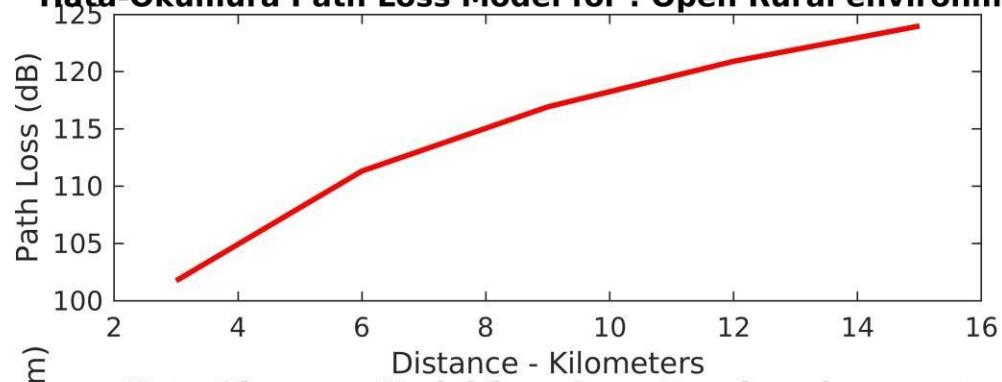
- 1 Big City (Urban model)
- 2 Small & Medium City (Urban model)
- 3 Sub-urban environment
- 4 Open Rural environment

Chosen Model : Open Rural environment

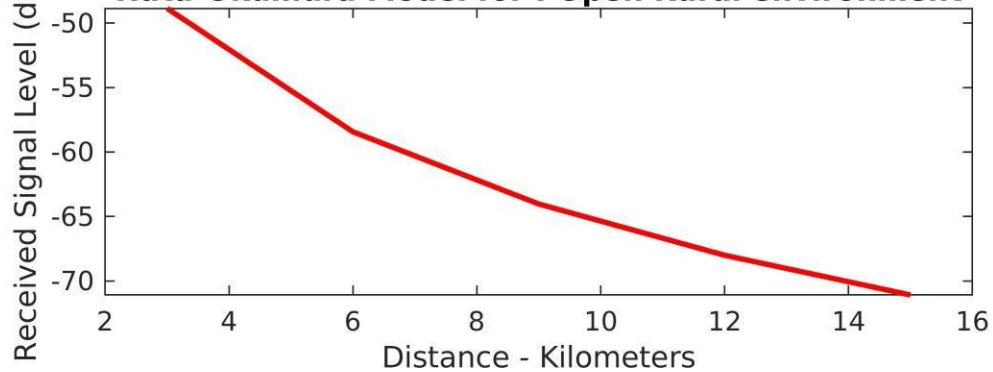
Pr = 1×5

-48.8637 -58.4364 -64.0361 -68.0092 -71.0909

Hata-Okumura Path Loss Model for : Open Rural environment



Hata-Okumura Model for : Open Rural environment



Conclusion:- I learnt about the Hata Okumura model using MATLAB.