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MATLAB Simulation Based Various Path Loss Prediction Model

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Abstract- ***In this article we aim to adopt a propagation model for Rourkela in which we examine the applicability of Okumura-hata model in Rourkela in GSM frequency band. We accomplish the investigation in variation in path loss between the measured and predicted values Through MATLAB graph was plotted between path loss verses distance. The mean square error (MSE) Was calculated between measured path loss values and those predicted on basis of Okumura-hata model for a sub-urban area.***

Keywords — *Path Loss, Hata Model, Okumura Model, Propagation delay,*

I. INTRODUCTION

Since the mid 1990's the cellular communications industry has witnessed rapid growth. Wireless mobile communication networks have become much more pervasive than anyone ever imagined when cellular concept was first developed. High quality and high capacity network are in need today, estimating coverage accurately has become exceedingly important. Therefore for more accurate design coverage of modern cellular networks, measurement of signal strength must be taken into consideration, thus to provide efficient and reliable coverage area. In this clause the comparisons between the theoretical and experimental propagation models are shown. The more commonly used propagation data for mobile communications is

Okumura's measurements and this is recognized by the International Telecommunication Union (ITU).

The cellular concept came into picture which made huge difference in solving the problem of spectral congestion and user's capacity. With no change in technological concept, it offered high capacity with a limited spectrum allocation. The cellular concept is a system level idea in which a single, high power transmitter is replaced with many low power transmitters. The area serviced by a transmitter is called a cell. Thus each cell has one transmitter. This transmitter is also called base station which provides coverage to only a small portion of the service area. Transmission between the base station and the mobile station do have some power loss this loss is known as path loss and depends particularly on the carrier frequency, antenna height and distance.

The range for a given path loss is minimized at higher frequencies. So more cells are required to cover a given area. Neighbour base stations close are assigned different group of channels which reduces interference between the base stations. If the demand increases for the service, the number of base stations may be increased, thus providing additional capacity with no increase in radio spectrum. The advantage of cellular system is that it can serve as many number of subscribers with only limited number of channel by efficient channel reuse.

1. Free Space Model

The wave is not reflected or absorbed in free space propagation model. The ideal propagation radiates in all directions from transmitting source and propagating to an infinite distance with no degradation. Attenuation occurs due to spreading of power over greater areas.

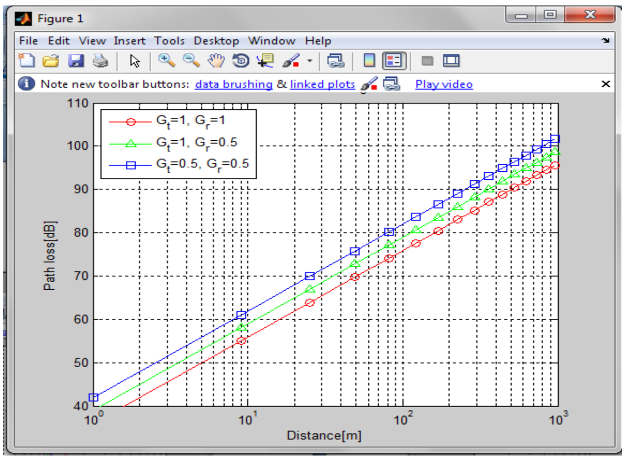

Fig 1 Free space Model

Here, we have simulated the results using MATLAB for various values of Gt and Gr for free space and it is clear from the above simulation that it gives minimum path loss for the Gt=1 and Gr=1 for the same distance as compared to others values of Gt and Gr. Here, path loss is measured in decibel and distance is measured in meters.

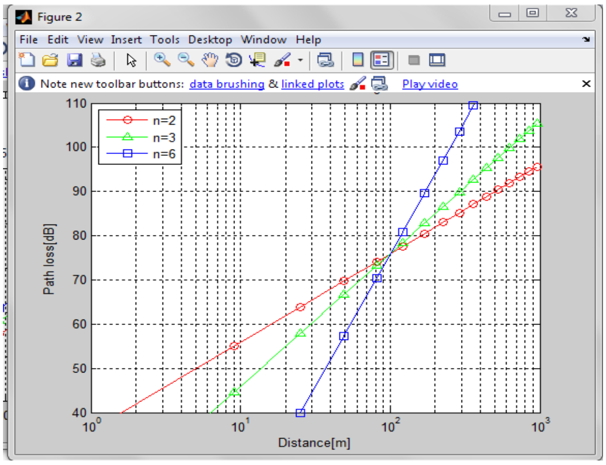

Fig. 2 Free space Model

In this Grpah we have simulated the various results for various values of n and it is clear that as value of n increases from 2 to 4 to 6 path loss is also increased thus it gives the best result for n=2.

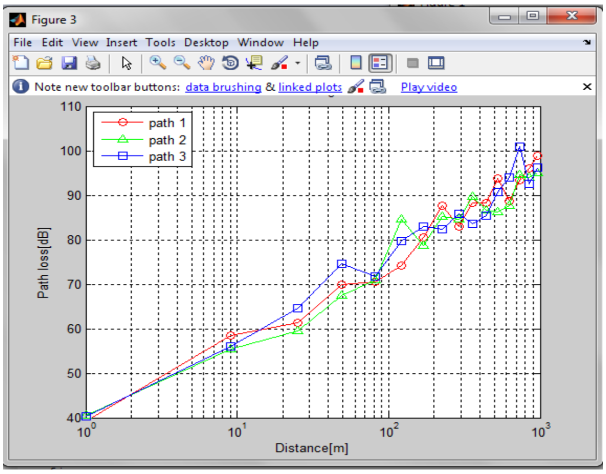

Fig 3 Free space Model

Here, We have simulated results for various paths and compared with each other.From the above graph it is clear that there are so many variations in the path loss and it is rapidly changing as distance changes for all of the three paths.

2. Hata Model

Hata for the 900 MHz band. This formula consists of an estimator of the standard deviation (s) along the measuring path in west of Amman city, Jordan. The estimator is calculated by a quadratic regression formula to reflect terrain roughness of the path taken. This estimator is used as a correction factor added to the urban formula proposed by Hata, for both urban and open areas categories. It is reported that the new estimator has less RMSE by an amount of 2.60 dB and 2.78 Db compared to Hata model for urban and open areas, respectively. Such an outcome illustrates the need for a terrain based correction formula in any accurate propagation model.

This model empirically formulates Okumura model by utilizing the graphical information retrieved by Okumura.Just like in the Okumura model, the applicable frequency range for the Okumura-Hata model is also 150 to 1500MHz, provides three separate formulae for each type of environment, namely: Urban area, Suburban areas and open area.It's main features are as follows,

- Most famous model: Okumura-Hata
- Okumura made extensive measurements

- Hata transformed Okumura‟s plots to an empirical model
- Valid for 150-1500 MHz
- Model takes the effect of

- Transmitter height *hb* in m
- receiver height *hm* in m
- frequency *fc* in MHz
- Distance *d* in km

Equation is given by

Lp = A + B log10(d) for urban area
A + B log10(d) − C for suburban area
A + B log10(d) − D for open area

where

A = 69.55 + 26.16 log10(fc) − 13.82 log10(hb) − a(hm)
B = 44.9 − 6.55 log10(hb)
C = 5.4 + 2 [log10(fc/28)]2
D = 40.94 + 4.78 [log10(fc)]2
− 19.33 log10(fc)

• Okumura and Hata's model is in terms of
– carrier frequency 150 _ fc _ 1000 (MHz)
– BS antenna height 30 _ hb _ 200 (m)
– MS antenna height 1 _ hm _ 10 (m)
– distance 1 _ d _ 20 (km) between the BS and MS.

• The model is known to be accurate to within 1 dB for distances ranging
from 1 to 20 km.

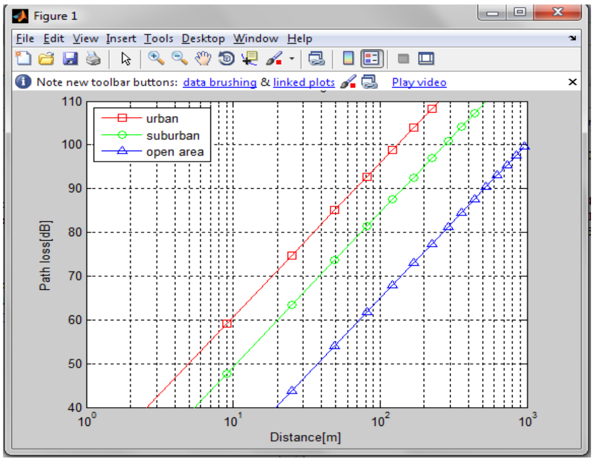

Fig. 4 Hata Model

Here we have simulated the result for hata model for the various channels like urban,suburban and open area channel.It is clear from the results that there is minimum path loss for the open area as compared to urban and sub urban area for hata model.

3. IEEE Model

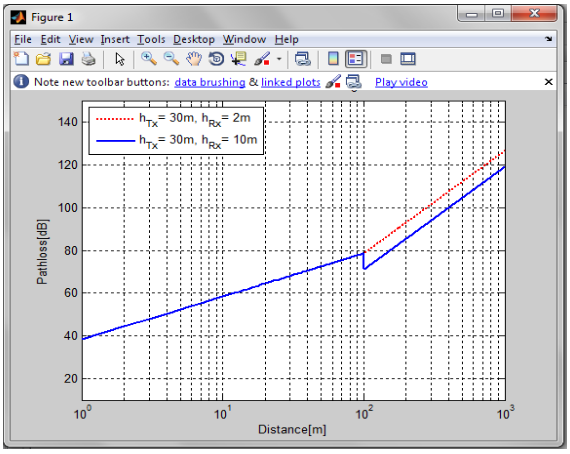

Fig .5 IEEE Model

Here, We have simulated the results for IEEE model for ht=30 m and hr=2m and hr=10m.Here height of transmitter antenna is fixed for both the cases and height of receiver antenna varies for both the cases. It is clear from the figure that as height of antenna increases path loss decreases and thus it provides the better result for hr=10 as compared to hr = 2.

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