A Novel Construction Technique for Reduction of Multipath Effects in Indoor Channels

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***Abstract* - In this report the ultra wide band signals are more affected due to EM waves propagated through irregular shaped bodies such as walls, buildings and hill areas multipath effects, too. MPCs are analyzed for various cases with several antenna heights and distances. Path delays (due to propagation through walls and various paths of direct and reflected rays) and the ringing (similar to UWB propagation through wall) can be clearly observed and analyzed. This paper provides a new proposal where an antenna is used in (40-60GHz) frequency range to reduce the effect of Multipath path fading coefficients.**

Keywords - UWB, Multipath Fading, EWP

1. INTRODUCTION

Wireless communication is the transfer of information between two or more points. Wireless operations permit services, such as long-range communications, that are impossible or impractical to implement with the use of wires [1]. One of these is the development of applications based on the location of a DOA of a signal.

The UWB concept is very useful for short range communications [1], [2], [3]. UWB spectrum was allocated by FCC as any radio technology having a spectrum that occupies a -10 dB bandwidth greater than 20 percent of the center frequency or a -10 dB bandwidth of at least 500 MHz Due to the limitation of UWB (especially concerning the power), Estimating the position of a radiolocation point in the presence of the MPC requires solutions with certain level of complexity either in the mathematical methods used (resulting in amounts of considerable processing time, introducing a further cause of error in the estimation) or using dipole arrays or directional antennas (which are obtained by using some type of reflector) in order to concentrate as much as much energy as possible.

Compared to ordinary communication in UWB pulse period is used below 1 ns , resulting in a bandwidth of over 1 GHz, and the second important parameter is that the signal can be transmitted with no carrier .This is why very often the system is also referred as Impulse Radio(IR).Therefore the signal will require the modifications of the signal format and detection of radiolocation point in Multipath environment

The radio signal transmitted is generally in the form of UWB system requirements. Because of this propagation analyses should be done for very wide frequency spectrum and simultaneously, the effect of various transmitted signal shapes (e.g. pulses) should be considered.

The resultant effect of different antenna receiving and transmitting responses as well as UWB signals (pulses) are analyzed in [4]–[6]. Different combinations of signals, transmitting or receiving antennas (small and aperture antennas) and multipath propagation have been calculated and compared.

Therefore, consider an UWB system's with a dipole ability to resolve closely spaced multipath, it is of interest to understand how, with the larger bandwidth allocated by FCC and operating in the modified SV channel model proposed by the IEEE 802.15 working group, the performance of the radiolocation point tracking timing detector is very easy compared to general system approaches because the UWB working under millimeter frequency range

2. PAPER REVIEW

In this section, we first present the general model for channels, and then review the clustering models for the indoor multipath propagation channel and next we propose the dipole in millimeter frequency range in order to reduce the multipath fading effects. Finally simulation results shows the power patterns of the short dipole

3. PAPER SCOPE

In this report we discuss the UWB multiple access in a Gaussian channel and received signal model for energy calculation in order to identify the radiolocation point .The UWB signal propagation experiment was verified in modern office building and the propagation channel also uses two vertically polarized diamond dipole antennas provide a collection of results of recovered signal locations (delay and azimuth)

4. CHANNEL MODELS

The optimal detection of indoor radio location is best described by its type channel model and also verifies the parameters based on radio signal. Many researchers working on different model of channels [4]. Based on the previous simulation and theoretical results one common pheomonena is that, how a radio signal can be best way of described interns of its channels behavior and its charectorsticts in multipath environments. The MPC occurs when signal can be traversed in different directions with different fading coefficients because the signal undergoes several changes such as reflection, refraction diffraction, scattering, etc. In Fig. 1 is represented simply the Phenomenon of multipath when transmitted.

A typical time-hopping format used in this case can be represented as

$$s_{tr}^{(k)}\left(t^{(k)}\right)=\sum_{j=-\infty}^{\infty}\omega_{tr}\left(t^{(k)}-j\mathrm{T}_f-c_j^{(k)}\mathrm{T}_c-\delta d_{\left[j/\mathrm{N}_s\right]}^{(k)}\right) \quad (1)$$

Where $t^{(k)}$ is the k[th] transmitters clock time and T_f is the pulse repletion time .The transmitted pulse wave form ω_{tr} is referred as a monocycle.

Due to the multipath propagation signal can be transmitted in different directions with different path delays and may be arrived at the receiver and delay is directly proportional to the path length between the transmitter and the UE (User equipment) which results in interference For a UWB signal a high resolution of multipath channel is expected along with the type of antennas in which the radiates electromagnetic energy equally in all directions (Omni directional) i.e. least delay and azimuth

In general the received signal model can be represented as

$$r(u,t)=s(u_s,t)+n(u_n,t) \quad (2)$$

Where **u** characterizes the set of parameters defining the environment (position of the receiver in the indoor environment) which simply act as energy capture function

5. THE UWB SIGNAL PROPAGATION EXPERIMENT IN INDOOR CHANNELS:

Mostly an antenna performs transmission as well as reception, and is vital component of any communication system. When electromagnetic signal is applied to the antenna input. The result is a current and a voltage distribution. Directional antennas plays major role in the beam width of an antenna, the loss of radiated power is 3 dB of its maximum value.

Another important aspect is the antenna gain is a measure of the directivity of the antenna. Hypothetical antenna is nothing but the Omni directional antenna or an isotropic radiator is used. If a particular amount of power is applied to an isotropic radiator ,it produces certain amount of field strength at certain distance ,which is same in all directions

The expressions of the magnetic field and electric field of a thin dipole in the far field is [24]

$$\mathrm{H}_\phi=\frac{j[\mathrm{I}_0]}{2\pi r}\left[\frac{\cos\left[(\beta L\cos\theta)/2\right]-\cos\left[(\beta L)/2\right]}{\sin\theta}\right] \quad (3)$$

$$E_\theta=\frac{j60[\mathrm{I}_0]}{r}\left[\frac{\cos\left[(\beta L\cos\theta)/2\right]-\cos\left[(\beta L)/2\right]}{\sin\theta}\right] \quad (4)$$

Where,

β is the function of the frequency

L is the length of the antenna

n is the dipole length factor

The bracketed term in the above equations (3) and (4) decides the shape of the power pattern and is also known as form factor

The equation of the form factor can be written as

$$ff=\left[\frac{\cos\left[(2\pi\,\mathrm{n}\cos\theta)/2\right]-\cos\left[\pi\,\mathrm{n}\right]}{\sin\theta}\right] \quad (5)$$

From the above equation (5) n, θ are the deciding factors of the power pattern shape and is independent of frequency.

Simulation results show that the power pattern depends on the variation of n values as well as it covers the large sector area which results in increased number of sectors. The length of the dipole is inversely proportional to the frequency and is shown in the figure (3).

A UWB signal propagation experiment was performed in a typical modern office building [5] is described. The bandwidth of the signal used in this experiment is in excess of 1 GHz, resulting in a different path delay resolution of less than a nanosecond.

The transmitter is kept stationary in the central location of the building. Multipath profiles are measured using a digital sampling oscilloscope on one floor at various at various locations. In each office multipath measurents are made at different locations. Measurements from 3 different offices are used .In these offices the receiving antennas are located at 6, 10, 17 m away from the transmitter representing typical UWB signal transmission characterized as a High SNR environment,Low SNR environment, and Extremely low SNR environment. The transmitter and receiving antennas are located at different rooms in these cases and it provide transmitted pulse shape captured at 1m separation from the transmit antenna

The second propagation experiment uses Two vertically polarized diamond dipole antenna each 1.65 m above the floor and 1.05 m below the ceiling in an office environment. The equivalent received pulse at 1m in free space can be estimated as the direct path signal in an experiment in which there is no multipath signal .Collection of result of recovered signal locations (delay and azimuth) is shown in the simulated plots. The channel response was shown in the figure 4.

6. CONCLUSIONS AND FUTURE WORK

In this report when we use the UWB for radio location point due to low power level its difficult estimate the position .so we are using vertically polarized dipole which gives high energy sectors to provide accurate radio location and reduces the MPC.Therefore UWB working under the concept of pulse presence and absence this is very useful for radiolocation.

Another important consideration is when UWB with dipole working in millimeter frequency range truly minimize the MPC or not that depends on accurate channel model. If the accurate resolution is not possible then try to change the features of the channel model..

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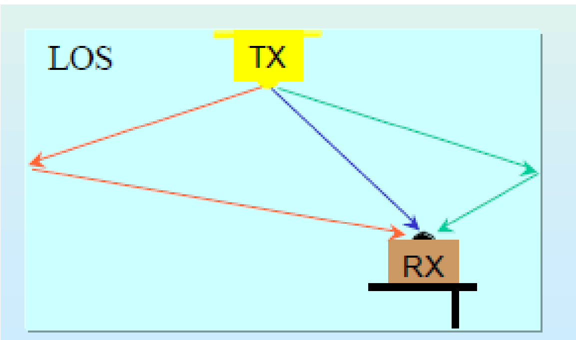

Figure 1: Multipath phenomenon

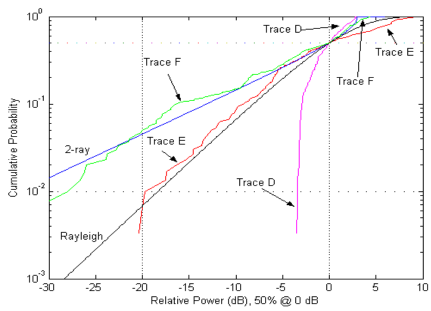

Figure2: plot of CDF under multipath environment

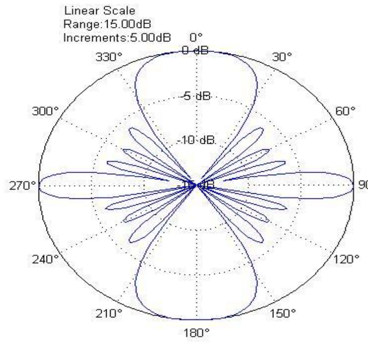

Figure 3: Power pattern of a short dipole.

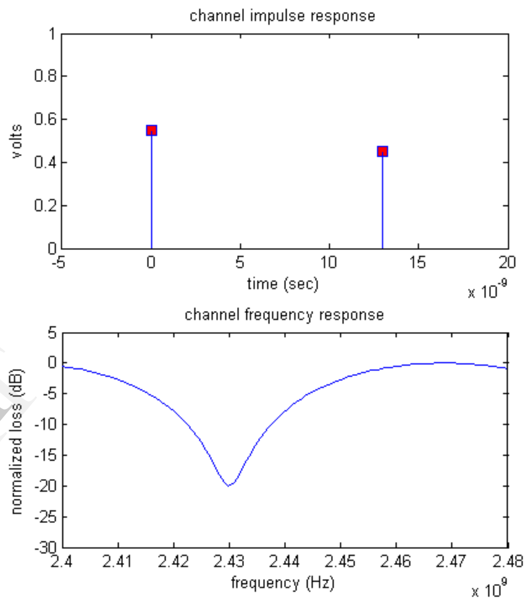

Figure 4 Channel responses in terms of dipole antenna

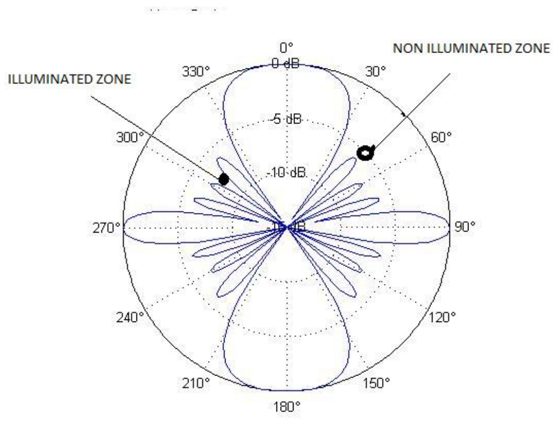

Figure 5: Illuminated – no illuminated zones