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Measurement Technique and Analysis of Mobile Radiation Tower

Anurag Misra

Department of Physics, DBS College CSJM University, Kanpur, U.P., India

Abstract: ***In this study, measurement of Electromagnetic (EM) radiation measurements in crowded residential areas were performed, and subsequent analysis of values recorded for the EM sources causing radiation was carried out. The obtained measurement levels were compared with the limit values given by International Commission for Non-Ionizing Radiation Protection (ICNIRP) and various***

Keywords: Power density, Non ionizing

1. Introduction

The current research was done to investigate the radiation pattern and power density from mobile towers in urban areas. The methodology involved in the research work is explained; in the current paper the measurements taken for calculations were repeated at different interval of time at same locations which were found to be most vulnerable to these radiations. It was found that there is variation in the measurement at different time. The pattern was almost same at all locations in the city and adjoining areas.

The observed values were taken in Kanpur city (India) and suburban areas at locations with multiple towers and density of population. During the survey work the following parameter were kept in mind.

1) Approx distance between the towers
2) The population around the towers
3) Schools and hospitals around the towers
4) Exact distance and height of tower from point of measurement (using GPS)

2. Review of Literature

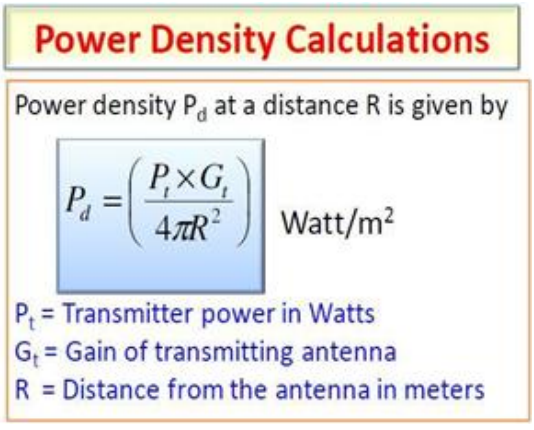
Over the last 15 years the use of mobile telephony has risen many folds. This has resulted in installation number of transmitting tower to cover wider area and users in urban areas. As the users increased more towers for transmission on mobile signals have been mounted. Today we can easily locate towers around us in fact in cities we see adjacent mast. These masts radiate 24 hrs 365 days. The radiations are electromagnetic in nature and are microwave. The frequency of operation is 2450 Mhz for 3G and could be up to 3.5 GHz for 4G. Radio waves and microwaves emitted by transmitting antennas are a form of electromagnetic energy collectively referred to as radiofrequency (RF) energy or radiation. The RF part of the electromagnetic spectrum consists of frequencies in the range of about 3 kilohertz (3 kHz) to 300 gigahertz (300 GHz). RF energy is used in telecommunications services, including radio and television broadcasting, mobile communication, GPS devices, radio communications. Majority of these towers are mounted near the residential and office buildings to provide good mobile phone coverage to the users

2.1 Methodology

GPS (Garmin USA) was used for location for measurement as records were maintained for repeat measurements and it was found that there is variation in power density at different interval of time. The distance measurement is one of the key factors required to calculate the distance between the tower and the point of observation and hence calculate power density required for calculation specific absorption rate. The format of survey data sheet was designed after discussion with the doctors to collect data of the required field for analysis. Survey data sheets were given to the volunteers to collect and analyzed. It is found that the people living around radiating or in close vicinity to the mast had problems like blood pressure, sleeplessness and fatigue are prominent amongst the age group of 30 45 years of such group of population. On the basis of data collected it was found that most of the places which were recorded showed power density more than the permissible limit and especially at the places where there were more than one radiating towers and each tower had more than one carrier. The physical problems observed show a relation between the power density around mast and population around it both living and floating. The places which had high density of power around the antenna had more population suffering with above mentioned problems.

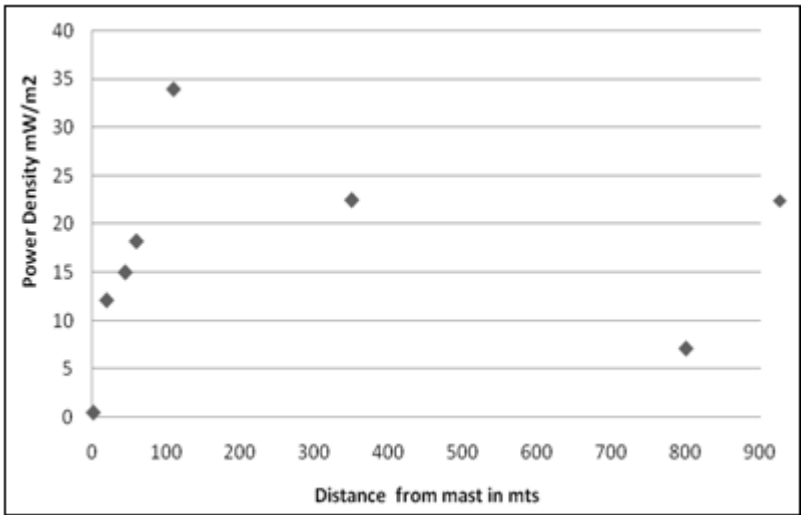
2.2 Formula Used

Power density from the mast is very important parameter. Power density decides the strength of transmission and magnitude. Higher the magnitude greater is the density which is parameter of study and concern. Power density was calculated as follows:



2.3 Observations

Transmitter power and Gain are takes as constant for a specific mast or tower R remains variable. The observations are taken at distance measured Using Garmin GPS. It is here important that observations taken at locations and distance from mast have to be repeated at different time of the day as the density tends to increase and decrease with number of users. On the basis of above formula the power density was calculated for different locations. Below is the graph which shows the power density variation w.r.t distance from mast. The graph below which shows the power density variation w.r.t distance from mast.



The graph shows that distance from transmitting antenna is important factor in residential areas. Maximum density was observed between 100 to 140 mts. This means that the people residing within this radar have highest exposure to the radiation which may result in serious consequences on human health and environment as a whole.

2.4 ICNIRP regulations

The International Commission on Non-Ionizing Radiation Protection (**ICNIRP**) is an international commission specialized in non-ionizing radiation protection. India follows ICNIRP regulations which says permissible limit for 900 MHz and 1800 MHz freq. transmission power density is 4.7 W/m^2 and 9.2 W/m^{2m} respectively averaged over 6 min exposure. ICNIRP has also given disclosure along with above guidelines that it intends to protect public against **short term gross heating effect and not against biological effect**. The experimental observations correlate to above disclosure as it was found that temperature of earlobe and around it increases by 1^0c when cell phone is used for more 20 mins or more.

To understand how safe the guide lines which are followed in India are we do some theoretical work. Here we calculate how much power is absorbed by human body is exposed to RF radiation under the guidelines which is **f/200** where f is frequency in MHz. If we take height of the body as 5'6" and width as 34" then area= 1.43 m^2 now at 940 MHz Power density (P_d) is 4.7W/ m^2

Power received P_r by human body is calculated as :

$$P_r = P_d \times \text{Area} = 6.75 \text{ Watts /Sec}$$

Now for whole day if a person is exposed to radiation then according to so called safe limits as followed by Indian mobile operators the microwave energy absorbed will be

(60x60x24) x 6.75 Watts =583.2 KW-Sec

Domestic microwave oven with 700-1000 W rating has around 60% efficiency considering microwave output as 500 W and comparing the above calculation we can conclude that human body can be safely kept in oven for 1166 secs = 19 mins. Who is this world will volunteer to do that?

3. Result

Most of the towers in the city are shared by more than one transmitter which may belong to one or more than one operator. The power density was found higher in case of multiple transmitter (5 carriers in current table).The table below shows the increase which is many folds considering the safe limit for exposure by ICNIRP is 4.7W/m2 and 9.2 W/m2 for 900 and 1800 Mhz

Table 1

Distance	P_dW/m2 (Single carrier)	P_dW/m2 (Multiple Carrier)
1	79.6	1194
3	8.84	126
5	3.18	47.7
10	0.796	11.94
50	0.031	0.477

For Pt=20; Gt=17 ;dB=50

Key observations of this research parameter are as follows :

- There is a vast variation of power output from the mast.
- The variation of intensity is seen with respect to distance
- Using Hypolog Spectran HF 4060 to record the peak value in terms of frequency and power output. This helped in calculation of power density.

4. Conclusion

During the field work it was observed that the measurements were not constant w.r.t time. The readings show variation when repeated at same spot over different time intervals. It was important to repeat the process at marked spot at different time frames which showed its dependence on usage of network**.**

Following precautions can help reduce the risk of mobile phones.

- Limit the amount of time you spend on the phone as 20 mins of continuous talk can raise the temperature around the ear by 1^0 C
- It is always safe to use wired hands free mode for talking like earphone or head phone. As the distance between ear and hand set is more the risk is reduced considerably keeping mobile set 8 cm reduces the risk
- As far as possible mobile phone should be used in good signal areas as when the signals are week the hand set radiates more and stronger radiation means more heating up of tissues around brain.
- Places like lift basement parking should be avoided

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