SAR reduction of a Two substrate multi feed antenna

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Abstract: **This paper presents a virtual view of antenna specific absorption rate minimization is presented, the benefits, procedure, objective and results on the same. Today fiber communication is in process. Antenna material is studied and simulated which can reduce the electromagnetic radiation, the electromagnetic radiation is absorbed by our model material. There is widespread opposition caused to the installments of antennas and various other devices due to the damage caused to human cells due to majority exposure to them. In this paper we present a new mixture of material and simulations to reduce electromagnetic radiation reduction in the environment to a considerable extent. Rahmat Samii in the paper [10] has shown about SAR reduction of implanted planar inverted F antennas with Non-uniform width radiator, Implanted PIFA radiation can be reduced effectively. We have used a cylindrical PEC material in addition we have also used a brass material which is minimum to reduce and attain the objective of radiation minimization. The PEC material and brass substrate reduced the electromagnetic radiation by more than 52%.**

Keywords: Brass, PEC, SAR minimization, multi feed line, power radiated.

I.Introduction:

5G operates between 30-60 gigahertz of frequency which should be having quite a minimum amount of latency in its operation. In this paper we are speaking of modern 5G and the measures of reducing antenna Specific absorption rate. We have successfully simulated a new material which can produce high date rate but at the same time cause less pollution. Our simulation is close to fifty percent effective in its proposal. We have achieved 52% reduction in SAR values by using a substrate in the outer shell of the antenna. In using biology in our research just as a matter of fact we know that cactus as a plant absorbs the radiation caused due to communicationm but in humans as we know cause a lot of cell damage when the radiation penetrates them for long exposure causing health risks and even cancer and biological cell damage when exposed to large amounts of time. We study a microstrip circular patch antenna which produces maximum radiation in the direction perpendicular to the strip besides causing minimum radiation in the direction of along the surface of the antenna.

II.Our Proposal

One of our cornerstone research in this paper is not just radiation reduction but also to reduce radiation wave losses which are waste and don't help in transfer of messages but cause a lot of energy waste and cause radiation of electromagnetic waves in the atmosphere. We want our antenna to use artificial intelligence and the technique is derived from computer vision and tesla smart driving cars. We know that tesla latest advancement of cars in which a remote control can control a car which is controlled to drive in any direction but the technology is very nascent form which is yet to be developed. We want to use this technique in which the computer detects which object is required. This is used in self driving cars in the future in which it detects backward and forward moving cars and in addition to that detects signals and sideways objects and pedestrians. We have used this technique in our research in which the antenna sends our electromagnetic waves at the speed of three into ten to the power 8 and at this speed detects which direction there is a mobile device and conducts its energy transmitting only to that device and thereby stopping energy wastage and radiation pollution in the environment.

III.Adding a brass endng on both sides as substrate in circular patch microstrip antenna

We have used a ground, and circular patch antenna in which we have added a brass lining in both sides to reduce the radiation. We have used side material as brass in our lining as to solve our objective. What brass will do is reduce the radiation caused by absorbing it.

The increasing awareness about the increased exposure to electromagnetic radiation which poses serious health hazards to human tissues and body is well known. The electromagnetic radiation causes cancer, alzheimers, brain disorders, skin diseases and many more diseases. The investigation in this paper is to solve this problem of electromagnetic radiation. We have tried to model a brass substrate which is of dimensions radius 6units and focal length as 3 units. We have simulated for the substrate which can effectively

reduce the radiation caused by electromagnetic radiation in the vicinity of the users head. This device will be useful in regions where there is high levels of radiation or where there is increased radiation which is to be reduce damage to brain tissues. We know that anachroic chamber absorbs heat when electromagnetic radiation gets hit on its surface similarly is the human tissues absorbs electromagnetic radiation when they gets absorbed on the body's surface. The brass substrate is made up of brass, this brass is thought to block electromagnetic radiation considerably. This process is known as the faraday cage which can absorb radiation considerably. Aluminium foils are even used to protect from nuclear radiation, though in this paper we are researching on electromagnetic radiation reduction by brass materials. Within everyone using electronic devices, the amount of electromagnetic radiation in the atmosphere affecting the human tissues has increased. This is expressed as SAR units of W/kg, expressed aroung the body or localized in 1g or 10g of tissue. According to the estimated IEEE standards, frequency range of 100KHz to 3GHz, the exposure to mosty parts is 1.6 W/Kg SAR value. SAR is the amount of energy absorbed by the human tissues when exposed to electromagnetic radiation. We have devised a antenna implant which significantly reduces the radiation absorbed by the human body. SAR depends on the electric field concentration of the near field region. Expressed as $\bar{V}(\bar{V} \cdot A)$, this is a relation between electromagnetic radiation for unit area of space. We propose antenna SAR reduction technique. We have used finite difference time domain method(FDTD) is estimation the SAR reduction analysis in addition to a human head model. FDTD method has been used for the calculation of scattering parametrs for many years. We are incorporating SAR reduction by using copper and aluminium, mostly brass material in this paper.

Figure I:Design in CST

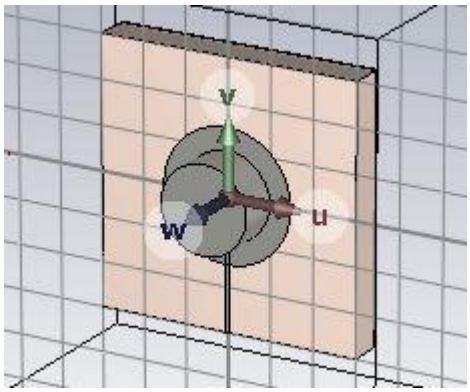
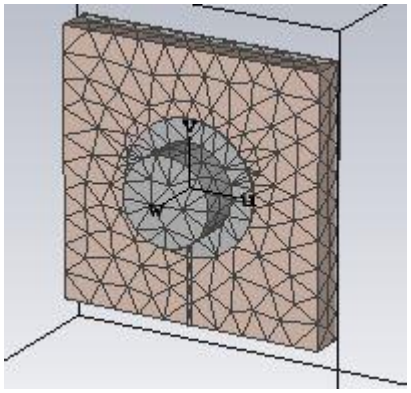


Figure II:Mesh control elements

This protruding design is of a brass circular element which is used on a circular patch antenna. The objective is solved in terms of frequency from 28-39 gigahertz. This shape redefines the beamforming analysis of our antenna.



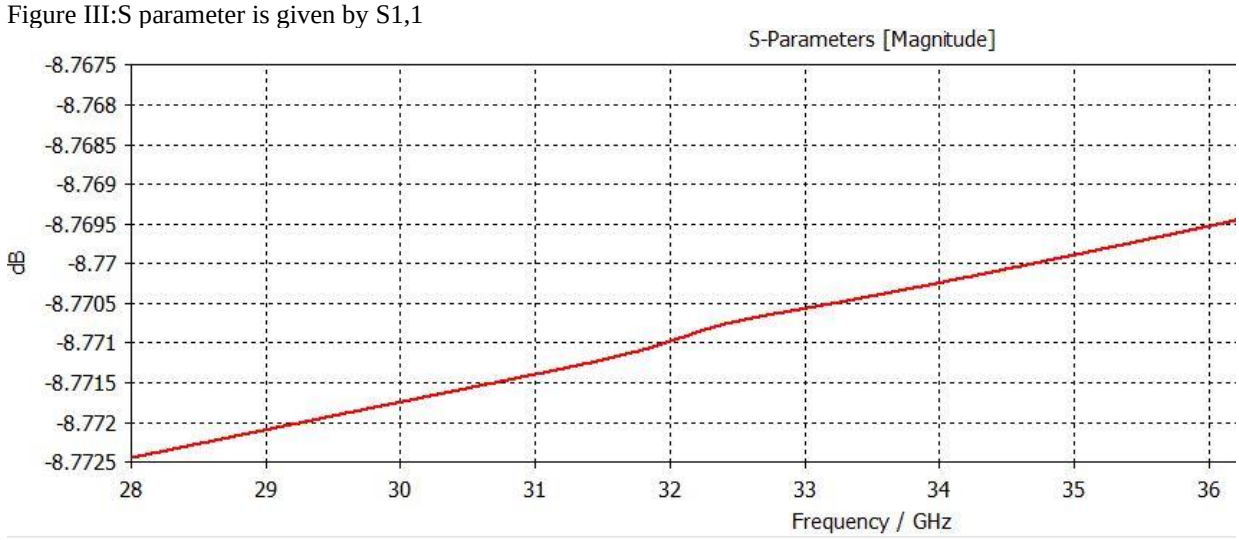
This structure has directional radiation pattern and offers update gain, high efficiency and low specific absorption rate(SAR), analysis is conducted for frequencies from 28-39 GHz range, the proposed antenna is composed of two substrates PEC and brass substrate, The proposed antenna shows very good agreement in the free space and on body surfaces attached to it. This is kind of a hypothetical testing done with these materials which shows pretty good reduction in environmental electromagnetic radiation

reduction by the radiation getting absorbed by this surface. The calculated S_{11} on human surfaces are 5.96% less, which is the radiation emitted and absorbed by human tissues.

We know that instead of single band antennas dual band antennas are preferred for various benefits. The substrate material is a deciding factor which decides how the antenna functions and how the electromagnetic spectrum behaves around the surfaces.

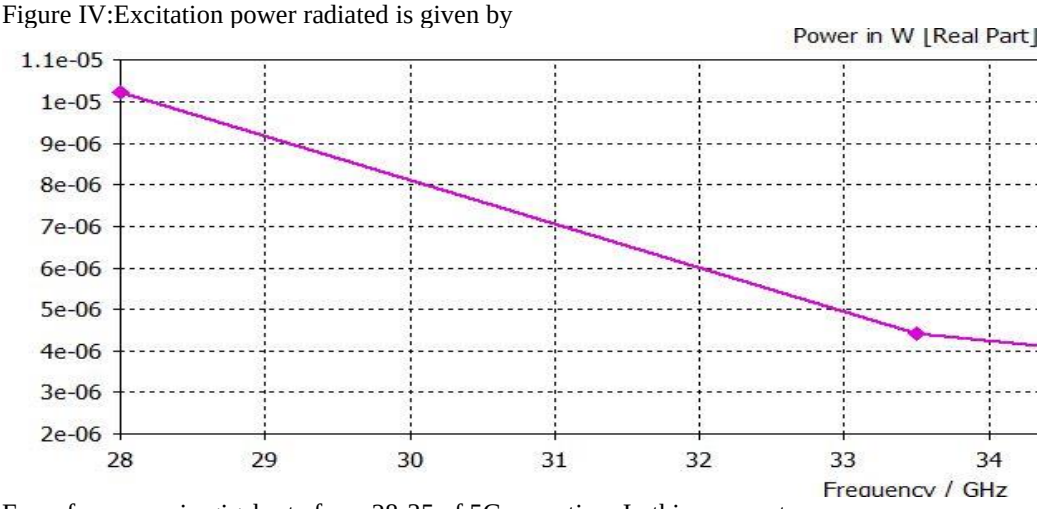
S_{11} is the parameter which shows the correlation between the signals received from multiple input multiple output systems(MIMO systems). Isotropic systems behave in a different way, which is faster and simpler. Less efficiencies are not uncommon in such systems. In order to estimate S_{11} and S_{22} from the time domain results the calculated voltages and currents are transformed into the time domain Discrete fourier transform analysis without any padding to provide the sampling interval.

The mesh control is used to study the design.
Figure III:S parameter is given by S1,1



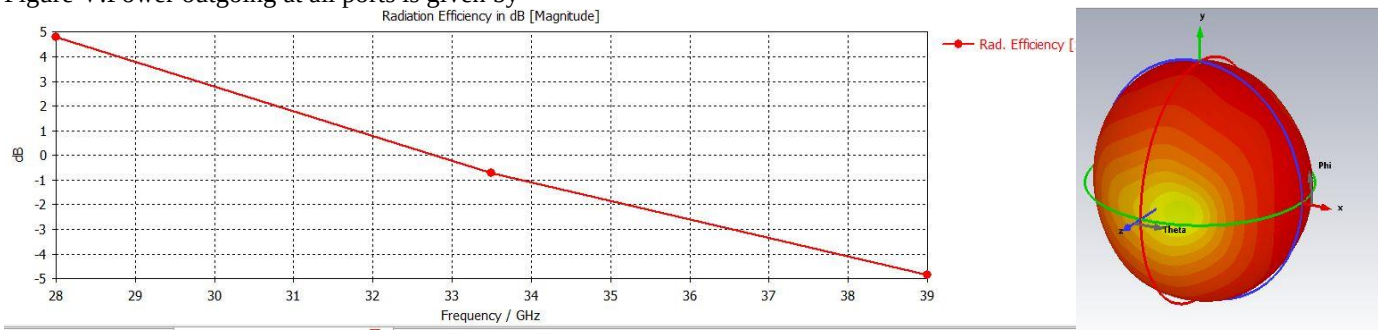
Millimetre wave antenna is a emerging area and is vastly developed in the last 10 years. In this paper we have simulated for a antenna material conjunction which reduces the antenna radiation. The amount of power utilized is more compared to the power radiated by the device. The received antenna is required to maintain the necessary requirements in order to measure the radiated field from a source and should balance the quality of the power radiated out. Several challenges are being faced and introduced in the mobile industry which needs to be tackled by researchers and industry throughout the world. At these frequencies there is a trade off between the path loss or the loss in signal to the high effective isotropic radiated power. Massive multiple input multiple output systems will have to be designed to meet the continuous demand of high data rates, better quality efficiency, and also how well this device functions in terms of its functioning.

Figure IV:Excitation power radiated is given by



From frequency in gigahertz from 28-35 of 5G operation. In this we want

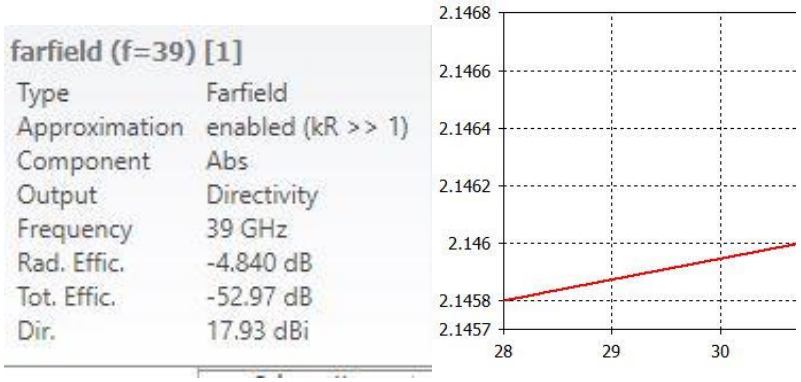
Figure V:Power outgoing at all ports is given by



The radiation efficiency is significantly linearly decreasing as the frequency is increased in the millimetre frequency range from 28 to 39 frequency.
The radiation efficiency due to the introduction of the brass is set to decrease from 28 to 39 gigahertz of frequency, nevertheless the power consumed is wasted but the radiation is caused to decrease considerably.

So in our research we are trying to use a latest development of circular patch antenna which reduces the area consumed in the patch antenna together with that it is serving multiple purposes. We know today in a small chip there are more than five billion transisters which amplify the signals supplied to it and modify them in multiple way to create our electronic industry which is doubling every two years and faster as stated by moores law in 1970s.

Figure VI: Farfield at 39 gigahertz and Voltage standing wave ratio of the power supplied to transmitted by values varying from 2.1458 in the y axis and increasing in 5G used frequency. Power transmitted by the antenna to the increase in frequency from 29 to 33 GHz.



Radiation efficiency defined for far field is -4.840 decibels to that of total efficiency of -52.97% which is the reduction in specific absorption rate(SAR) due to the introduction of the PEC material and the brass substrate. The material device does not depend on the frequency of operation.

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Conclusion: The availability of material is very important in the manufacture of electronic components in todays time. Today we are facing the shortage of chips due to the shortage of various raw materials in the form of silicon unvailability and more, and many industries are closing down mostly the subsidiaries of electronics industry such as automobile, electronics and more. In this paper we have successfully simulated a low radiation circular patch antenna using a brass material which consumes more electrical power from the increase of frequency from 28-39 gigabertz but emits and radiates less electromagnetic radiation. We have successfully simulated this material for electromagnetic radiation reduction by absorbing and reducing radiation by 52% which is almost half the reduction in radiation. Brass is a readily available material which can be easily incorporated into any antenna material to achieve the defined objective. The studied substrate is studied.The future scope of research would be in new materials in 5G communication which transmit and use lesser electrical energy.

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Availability of data:No data procured.
Code availability:No code available.

References:

[1] T. T. Le and T. -Y. Yun, "Wearable Dual-Band High-Gain Low-SAR Antenna for Off-Body Communication," in *IEEE Antennas and Wireless Propagation Letters*, vol. 20, no. 7, pp. 1175-1179, July 2021, doi: 10.1109/LAWP.2021.3074641.

[2] P. Hallbjorner, "The significance of radiation efficiencies when using S-parameters to calculate the received signal correlation from two antennas," in *IEEE Antennas and Wireless Propagation Letters*, vol. 4, pp. 97-99, 2005, doi: 10.1109/LAWP.2005.845913.

[3] X. Wang, H. D. Nguyen and H. T. Hui, "Correlation coefficient expression by S-parameters for two omni-directional MIMO antennas," *2011 IEEE International Symposium on Antennas and Propagation (APSURSI)*, 2011, pp. 301-304, doi: 10.1109/APS.2011.5996702.

[4] Wang, M., Yang, Z., Wu, J., Bao, J., Liu, J., Cai, L., Dang, T., Zheng, H. and Li, E., 2018. Investigation of SAR reduction using flexible antenna with metamaterial structure in wireless body area network. *IEEE Transactions on Antennas and Propagation*, *66*(6), pp.3076-3086.

[5] Ikeuchi, R. and Hirata, A., 2011. Dipole antenna above EBG substrate for local SAR reduction. *IEEE Antennas and Wireless Propagation Letters*, *10*, pp.904-906.

[6] Han, K., Swaminathan, M., Pulugurtha, R., Sharma, H., Tummala, R., Yang, S. and Nair, V., 2015. Magneto-dielectric nanocomposite for antenna miniaturization and SAR reduction. *IEEE Antennas and Wireless Propagation Letters*, *15*, pp.72-75.

[7] il Kwak, S., Sim, D.U. and Kwon, J.H., 2008, October. SAR reduction on a mobile phone antenna using the EBG structures. In *2008 38th European Microwave Conference* (pp. 1308-1311). IEEE.

[8] Il Kwak, S., Sim, D.U., Kwon, J.H. and Yoon, Y.J., 2016. Design of PIFA with metamaterials for body-SAR reduction in wearable applications. *IEEE transactions on electromagnetic compatibility*, *59*(1), pp.297-300.

[9] Chan, K.H., Chow, K.M., Fung, L.C. and Leung, S.W., 2005. Effects of using conductive materials for SAR reduction in mobile phones. *Microwave and optical technology letters*, *44*(2), pp.140-144.

[10] Kim, J. and Rahmat-Samii, Y., 2006, July. SAR reduction of implanted planar inverted F antennas with non-uniform width radiator. In *2006 IEEE Antennas and Propagation Society International Symposium* (pp. 1091-1094). IEEE.