SAR REDUCTION USING PLANAR INVERTED F-ANTENNA: A Review

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ABSTRACT

Cellular telecommunication is widely spreading around the world. Mobile handsets are often used in the vicinity of the human head. The continuous growth of wireless mobile services has forced the worldwide mobile handset manufacturers to consider the mutual interactions between the mobile terminals and human .The performance of mobile is altered due to the proximity of the human head due to SAR.Specific Absorption Rate (SAR) is a parameter which define the quality of the device lower is the value of SAR higher is the efficiency and lesser effects of RF on human body.The simplest method to significantly reduce SAR values is increasing the distance between the human head and the mobile handset antenna but using Planar Inverted F-Antenna (PIFA) is considered as one of the most appropriate antenna structures to reduce the SAR Now, the fourth generation of mobile communications, the Long Term Evolution (LTE), is expected to deliver multimedia services as a result usage and health risk has increased.This paper presents a novel and simple PIFA design for Long Term Evolution (LTE) mobile phone application.

INTRODUCTION:

Mobile cellular telecommunications services are becoming widely spread around the world. Mobile handsets are often used in the vicinity of the human head. The continuous growth of wireless mobile services has forced the worldwide mobile handset manufacturers to consider the mutual interactions between the mobile terminals and human body. On the one hand, part of the electromagnetic wave radiated by the antenna is absorbed by the human head. On the other hand, some mobile handset antenna characteristics, such as radiation pattern, radiation efficiency, bandwidth, and return loss, are altered due to the proximity of the human head. The mutual effect between the human head and the antenna have been investigated by many researchers. The Speci□c Absorption Rate (SAR) is a de□ned parameter for evaluating the power absorption in human tissue. To protect the users from hazardous RF exposure, safety guidelines or limits of SAR have been made by Federal Communication Commission (FCC). According to IEEE, SAR is the time derivative of the incremental energy absorbed by (dissipated in) an incremental mass contained in a volume element of given density (ρ) . The SAR limit is set at 2W/kg over any 10g of tissue according to IEEE C95.1:2005. This limit is comparable to the limit speci□ed by the International Commission on Non-Ionizing Radiation Protection guidelines. Planar Inverted F-Antenna (PIFA) is considered as one of the most appropriate antenna structures for mobile handset application due to many advantages including: low profile, simple structure, and reasonable antenna performance. PIFA structure is also attractive for designing multi-band antennas. These antennas are becoming essential for modern wireless communication systems. There are many methods proposed to PIFA structure to reduce SAR levels. The simplest method to significantly reduce SAR values depends on increasing the distance between the human head and the mobile handset antenna. This can be achieved by the application of back mounted

antenna for mobile handset or by profiling the handset. Other researchers try to reduce the radiation to human head by attaching a particular material to the antenna or mobile handset. Ferrite material has been an attractive material in reducing the SAR values. The effect of ferrite sheet attachment to mobile handset was also investigated by Wang et al. in 1999. The experiment is done using portable phone with a monopole antenna. The current from monopole antenna owns on all surfaces of the box. The ferrite sheet is used to suppress the current owing in the handset box resulting in a significant reduction of the SAR without altering the antenna performance.

PIFA is formed from a linear Inverted F antenna (IFA) where the wire radiator element of IFA is replaced by a plate to enhance the bandwidth performances. The PIFA have some unique characteristic that makes it suitable for use in portable wireless device especially on mobile handsets. It has several advantages compared than other micros trip antennas. It has a low profile, small size and can locate in structure such as at the back cover of the mobile phone . The other major compensation is it is easy to fabricate, low manufacturing cost, and simple structure. It also has low SAR value where it has a small backward radiation toward the user's head and reducing the electromagnetic wave power absorption and increase the antenna performance.

HFSS (High Frequency Structure Simulator)

–"HFSS is the industry-standard software for S-parameter, full-wave SPICE extraction and electromagnetic simulation of high-frequency and high-speed components. HFSS is widely used for the design of on-chip embedded passives, PCB interconnects, antennas, RF/microwave components, and high-frequency IC packages."

Common HFSS Applications

–Antenna

•Planar Antennas -Patches, Dipoles, Horns, Conformal Cell Phone Antennas, Spirals

•Waveguide –Circular/Square Horns

•Wire –Dipole, Helix

•Arrays -Infinite Arrays, Frequency Selective Surfaces (FSS) & Photonic Band Gaps (PBG)

•Radar Cross Section (RCS)

LITERATURE SURVEY:

1. G., J. Johnson proposed "Experimental study on compact, high-gain, low SAR single- and dual-band patch antenna for cellular telephones," according to which The presence of the human head and hand significantly alter the performance of cellular telephones. A considerable fraction of the power (30-70 percent) is generally absorbed by the human body, causing SAR concerns and drastic reduction in antenna efficiency. The use of high-gain, broad-band, microstrip patch antenna would alleviate the problem, leading to low SARs without decrease in radiating performance of the cellular telephone.

Because of the reduced absorption in the head and resulting lower SARs, the patch antennas will require less power leading to longer battery life

2. Park, J. D., B. C. Kim, and H. D. Choi proposed "A low SAR design of folder type handset with dual antennas"In this study, a folder type mobile phone that has dual antennas was designed to reduce SAR (specific absorption rate) on the human head. One of the antennas is a PIFA (planar inverted-F antenna) that is inserted in the folder case, the other is typical monopole antenna. In order to achieve optimal performance from these antennas, the phone was designed such that the PIFA is operated only when the phone is used near the head with the folder opened. When phone is not used with the folder closed, the monopole antenna is operated in order to prevent deterrence of radiation that happens when the main beam of a planar antenna is directed to the human body.

3. IEEE Std C95.1-2005, proposed "Safety levels with respect to human exposure to radio frequency electromagnetic fields, 3kHz to 300GHz,". IEEE Standard, 2006 Recommendations to protect against harmful effects in human beings exposed to electromagnetic fields in the frequency range from 3 kHz to 300 GHz are provided in this standard. These recommendations are intended to apply in controlled environments and for general population exposure. These recommendations are not intended to apply to the exposure of patients by or under the direction of physicians and medical professionals.

4. Mahmoud, R.K proposed "the interaction between a human head and a smart handset for 4G mobile communication systems," In this paper the interaction of the planar inverted-F antenna array, mounted on a mobile handset, with a human hand-head phantom is investigatedin the 1.9 GHz band. Firstly, the effect of the human hand-head on the handset radiation characteristics is studied. Then, the spatial peak specific absorption rate (SAR) values of 4-element antenna arrays for mobile handsets in the vicinity of a human hand-head are evaluated numerically for different scenarios. The antenna is analyzed completely using finite difference time domain (FDTD)while the interaction is performed using the CST Microwave Studio software

5. Amos, S. V., M. S. Smith, and D. Kitchmer,proposed the "Modeling of handset antenna interactions with the user and SAR reduction techniques," according to paper Today's mobile phones require proof of compliance to standard limits of the specific absorption rate (SAR), before they can be allowed onto the market.This requirement is set by standard committees worldwide.The article presents an investigation which highlights how handset designs employing common elements such as the whip and PIFA are very sensitive in their resulting SAR averages when alterations to the structures are included.

PROBLEM STATEMENT:

1. Calculation of antenna parameter by using transmission line equation.
2. Modeling of antenna using HFSS Software.
3. Simulation and optimization of antenna using HFSS simulator.
4. Analysis of antenna design using HFSS software.
5. Calculation of Return loss.
6. Observation of Radiation pattern.
7. Calculation of VSWR.
8. Observation of Radiation efficiency.
9. Calculation of SAR using CST software.

RESEARCH METHODOLOGY:

CST STUDIO SOFTWARE (Computer Simulation Technology):The electromagnetic simulation software CST STUDIO SUITE® is the climax of numerous long periods of innovative work into the most precise and effective computational solutions for electromagnetic designs. It comprises CST's tools for the design and enhancement of gadgets working in an extensive variety of frequencies - static to optical. Analyses may include thermal and mechanical effects, as well as circuit simulation. CST STUDIO SUITE profits from an integrated design environment which offers access to the entire range of solver technology. System assembly and modeling facilitates multi-physics and co-simulation as well as the management of entire electromagnetic systems. CST STUDIO SUITE can offer impressive item to showcase preferences, for example, shorter improvement cycles, virtual prototyping before physical preliminaries, and enhancement rather than experimentation. The CST outline condition is regular over every one of the modules in CST STUDIO SUITE®. Including a 3D demonstrating device and a schematic format device, the plan condition consolidates a pre-processor for the solvers and an instinctive interface for the client. For ventures that traverse different modules, this mutual interface streamlines the simulation work process. Not exclusively can models and fields be exchanged starting with one simulation then onto the next, yet the client can work these modules utilizing a similar Ribbon-based interface. The Ribbon utilizes tabs to assemble every one of the tools and alternatives expected to set up, do and analyze a simulation, as per their situation in the work process. Contextual ribbon tabs imply that the most significant alternatives for the assignment are constantly only a click away. The Ribbon, close by with the Project Wizard and the Quick Start Guide, gives direction to new clients and offers access to an extensive variety of features.

The 3D modeler at the core of the interface utilizes the ACIS 3D CAD bit. This powerful tool enables models to be developed inside CST STUDIO SUITE and altered parametrically with a straightforward WYSIWYG approach. 2D and 3D field results are presented model itself, with various conceivable methods for survey the information, including animation. Notwithstanding the 3D modeler, CST STUDIO SUITE likewise incorporates a block based schematic tool, CST DESIGN STUDIO™ (CST DS). And in addition offering circuit simulation, CST DS additionally enables models to be connected together and simulated, utilizing System Assembly and Modeling (SAM)to develop a perplexing framework from simpler components. The CST plan design environment is likewise perfect with OLE mechanization, permitting simulation and post-processing to be controlled through external applications, for example, Excel or MATLAB, so information can be separated naturally for further investigation.

CONCLUSION:

In this paper, we have attempted to do an intensive survey of the works done by various researchers on PIFA technology. The low SAR mobile terminal antenna is designed, simulated, and fabricated. The increased gain and reduced current owing on the chassis decreases the radiation toward the human head and so reduces the SAR value. Simulations and measurements agree well and show that the SRF of the proposed structure in order to overcome some challenges such as the insufficient matching and bandwidth. In this review some of the important aspects of PIFA technology and PIFA design are considered. Various design considerations and applications are evolving in this area. Size reduction is valuable for modern communication terminals. More research works and studies are needed to Reduce the overall height will reduce the antenna bandwidth, and more investigation is currently directed towards reducing the size, while maintaining attractive SRF and we expect it to have a good future in the quickly developing field of wireless technology**.**

REFRENCES:

2. Lazzi, G., J. Johnson, S. S. Pattnaik, and O. P. Gandhi, "Experimental study on compact, high-gain, low SAR single- and dual-band patch antenna for cellular telephones," IEEE Antennas and Propagation Society International Symposium, Vol. 1, 130– 133, 1998.

3. ICNIRP Guidelines, "Guidelines for limiting exposure to time varying electric, magnetic and electromagnetic elds up to 300GHz," Health Phys., Vol. 74, No. 4, 1998.

4. Amos, S.V., M. S. Smith, and D. Kitchmer, "Modeling of handset antenna interactions with the user and SAR reduction techniques," IEE National Conference on Antennas and Propagation, 12–15, York, UK, 1999.

5. Park, J. D., B. C. Kim, and H. D. Choi, "A low SAR design of folder type handset with dual antennas," IEEE Antennas and Propagation Society International Symposium, Vol. 2, 1005–1008, 2003.

6. Kivekas, O., J. Ollikainen, T. Lehtiniemi, and P. Vainikainen, "Bandwidth, SAR, and efficiency of internal mobile phone antennas," IEEE Trans. Electromagn. Compat., Vol. 46, No. 1, 71–86, 2004

7. Saraereh, O. A., M. Jayawardene, P. McEvoy, and J. C. Vardaxoglou, "Simulation and experimental SAR and efficiency study for a dual-band PIFA handset antenna (GSM 900/DCS 1800) at varied distance from a phantom head," IEE Antenna Measurements and SAR, 5–8, 2004

8. IEEE Std C95.1-2005, "Safety levels with respect to human exposure to radio frequency electromagnetic elds, 3kHz to 300GHz," IEEE Standard, 2006.

9. Kitra, M. I., C. J. Panagamuwa, P. McEvoy, J. C. Vardaxoglou, and J.R.James, "Low SAR ferrite handset antenna design," IEEE International Workshop on Antenna Technology Small Antennas and Novel Metamaterials, 144–147, 2006.

10. Ebrahimi-Ganjeh, M. A. and A. R. Attari, "Interaction of dual band helical and PIFA handset antennas with human head and hand," Progress In Electromagnetics Research, Vol. 77, 225–242, 2007.

11. Hirata, A., K.Shirai, andO.Fujiwara, "On averaging mass of SAR correlating with temperature elevation due to a dipole antenna," Progress In Electro magnetics Research, Vol. 84, 221–237, 2008.

12. Mahmoud, K. R., M. El-Adawy, S. M. M. Ibrahem, R. Bansal, and S. H. Zainud-Deen, "Investigating the

interaction between a human head and a smart handset for 4G mobile communication systems," Progress In Electromagnetics Research C, Vol. 2, 169– 188, 2008.

13. Kouveliotis, N. K. and C. N. Capsalis, "Prediction of the SAR level induced in a dielectric sphere by a thin wire dipole antenna," Progress In Electromagnetics Research, Vol. 80, 321–336, 2008.

14. Cheng, P.-C., C.-Y.-D. Sim, and C.-H. Lee, "Multi-band printed internal monopole antenna for mobile handset applications," Journal of Electromagnetic Waves and Applications, Vol. 23, No. 13, 1733–1744, 2009.

15. Zuo, S. L., Z. Y. Zhang, and Y. Z. Yin, "A planar meander monopole antenna for DVB-H/GSM/DCS mobile handsets Journal of Electromagnetic Waves and Applications, Vol. 23, No. 17–18, 2331–2337, 2009.

16. Christopoulou, M., S. Koulouridis, and K. S. Nikita, "Parametric study of power absorption patterns induced in adult and child head models by small helical antennas," Progress In Electro magnetics Research, Vol.94, 49–67, 2009.