DESIGNING PIFA ANTENNA FOR SAR MINIMIZATIONUSING HFSS

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ABSTRACT-

The goal of this paper is to look at the effects of electromagnetic field exposure on humans and to lower the specific absorption rate (SAR). This research focuses on the application of various electromagnetic shield materials, such as ferrite, that are currently employed to reduce SAR. The experimental analysis uses a 2.6 GHz radiation source as its radiation source. The PIFA (Planar Inverted-F Antenna) is positioned in front of a cube with dielectric properties that are similar to those of human tissue. For different shield materials, the SAR reduction factor (SRF), SAR 1 g, gain, directivity, and beam width are computed. In this work, the material is investigated and proposed as a good shield material for SAR reduction. SAR values of 0.194 W/Kg were achieved using this unique implementation method the findings show that ferrite-absorbing material and its composites are excellent shielding materials for reducing SAR.

Keywords: Planar Inverted F Antenna, HFSS software, Specific Absorption Rate

INTRODUCTION

Radio frequency and microwave (RF/MW) radiation sources, particularly cellular phones, are ubiquitous. RF and MW sources are ubiquitous, but they also raise concerns about the potential biological impacts of microwaves. It is critical that the biological effects of RF and MW fields be kept to a minimum, at least to the level of clinical relevance, in order to assess health risk. Because the effects of RF/MW fields on human health have yet to be fully understood, the basic knowledge gained through laboratory investigations using cellular and animal test systems is extremely significant. In cellular communications, the interaction of handset antennas with the human body is a major consideration. Radio frequency and microwave (RF/MW) radiation sources, in particular the antenna voltage standing wave ratio (VSWR), gain, and radiation patterns are influenced by the user's body, particularly the head and hand. Furthermore, thermal impacts can pose a severe health threat when tissues are subjected to infinite electromagnetic energy. As a result, exposure limits in terms of a particular absorption rate have been established by standards organizations (SAR). To keep antenna designs under SAR restrictions, all RF designers are interested in SAR reduction. However, there is a greater emphasis on improving the efficiency of gadget performance than on analyzing the level of compromise that leads to human health degradation as a result of exposure. Existing research focuses more on protecting the antenna design's structure than on achieving significant SAR reduction.

RELATED WORKS

Many of the scientists have proposed and contributed their work to design the PIFA antenna for SAR minimization using HFSS software. Hamza Ben et al. [1] proposed a novel design for a multi-band PIFA antenna. It reduces the specific absorption rate (SAR) for mobile and wireless applications. It demonstrates improved performance in developing safer and more efficient mobile communication systems. Nurul Inshirahet al. [2] Employ a simulation-based approach to optimize the antenna's performance and minimize SAR values. Demonstrate the effectiveness of the proposed design in terms of radiation pattern, impedance and bandwidth. Offers valuable insights for developing safe and high performance PIFA antennas for mobile and wireless applications. J.D. Park et al. [3] It investigates the impact of antenna placement and orientation on SAR levels. Results show that SAR levels can be reducedby optimizing antenna placement and orientation. Offers insights for designing safer and more efficient mobile devices G. Venu et al. [4] PIFA involves determining the dimensions of the antenna's radiating element, ground plane, and feeding mechanism. PIFAs can be designed to operate in a wide range of frequency bands, including cellular, Wi-Fi, Bluetooth, and GPS. Factors such as bandwidth, radiation pattern, and efficiency must be carefully considered during the design process to ensure optimal performance of the PIFA antenna in a mobile communication device. Prabir et al. Different materials have different electromagnetic properties, which can impact the SAR levels. The choice of materials can have a significant impact on the resulting SAR levels. By selecting appropriate materials, it may be possible to reduce SAR levels and improve the safety of mobile phone use.

SHIELDED MATERIALS

Ferrites are materials that have both an electric and a magnetic cap. Ferrites are materials that have both electrical and magnetic properties. Their distinct features allow for further investigation in the realm of EM investigations. A mixture of metal oxide and iron oxide is used to make ferrites. In nature, there are several types of rituals. The thickness of ferrites used as RF shields is investigated, and the thickness of these ferrites yields distinct SAR reduction values. Surface current can be suppressed using ferrite sheets. The location of the ferrite sheet attachment and its various sizes has a considerable impact on the SAR value. When a quarter-wavelength monopole antenna is mounted to a ferrite sheet in a conducting box, power absorption is minimized due to the ferrite sheet's radiation dissipation capabilities. Polymeric ferrites are formed when ferric oxides are present in polymers. Polymeric shielding materials are commercially available. The use of metal oxide ferrite and a specific composite barium ferrite has been tested. A type of hexagonal ferrite, barium ferrite oxide, is employed in screening applications. It has magnetic microwave capabilities and is resistant to stress in the environment. It does not necessitate the use of a magnetic field to bias it. Table 2 lists the electromagnetic properties of ferrites.

IMPACT ON SAR OF FERRITE SHEET ATTACHMENT

In this section, ferrite distances are placed between the antenna and a mortal head, also reducing the SAR value. In order to study the SAR reduction of an antenna operating in the GSM 2.6 GHz band,

Different positions, sizes, and accoutrements of ferrite distance for SAR reduction effectiveness are also anatomized by using ferrite sheet. Reduction of specific immersion rate (SAR) has now become a buzzword because of the growing health concerns over microwave oven exposure. Ferrites are set up to be effective at dwindling electromagnetic influence. In this reported work, Flexible ferrite alloys are characterized by the base of their shielding edge. SAR measures are carried out with a planar wearable antenna and ferrite shielding to confirm its capability

Sheet	Length(mm)	Width(mm)	Thickness(mm
Ferrite Sheet 1	90	1.5	0.2
Ferrite Sheet 2	90	1.5	0.2
Ferrite Sheet 3	90	45	0.2

Table-1: Different ferrite sheet dimensions

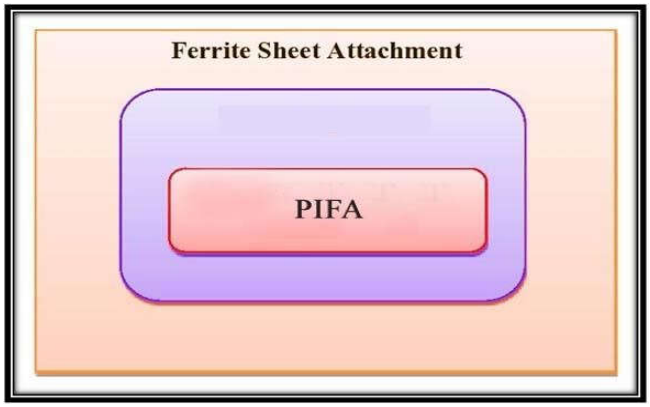

Fig. 1: Ferrite Sheet Attachment

Simulation Results

Return Loss: Figure 8 States Return loss of Planar Inverted F- Antenna of our proposed Ferrite Sheetattachment with Amended PIFA for SAR Reduction, Return loss is -14.10dB

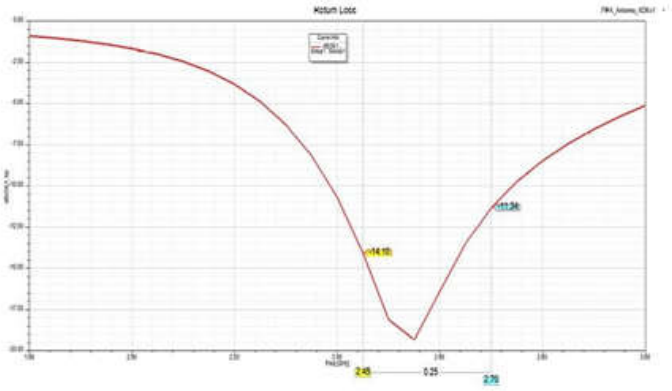

Fig. 2: Return Loss @ 2.6 GHz (Ferrite Sheet)

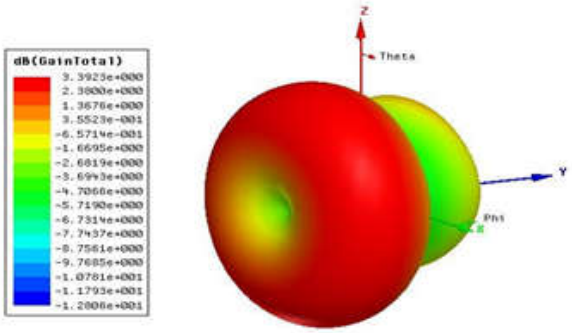

Fig. 3: Gain-States Gain of Planar Inverted F- Antenna of our proposed Ferrite Sheet attachment with Amended PIFA for SAR Reduction

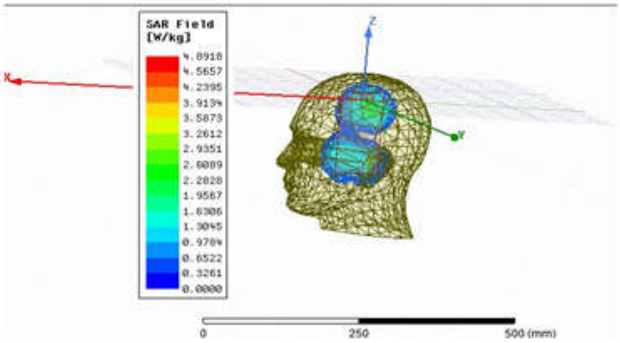

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Fig. 4: States Design of Planar Inverted F- Antenna of our proposed Ferrite Sheet attachment with Amended PIFA for SAR Reduction

Parameter	With Ferrite Sheet
Return Loss	-19.55
Gain(dB)	3.3
Bandwidth(GHz)	0.250
SAR(W/Kg)	0.326

Table-2: Ferrite sheet parameters

CONCLUSION

A modified Planar Inverted F-Antenna (PIFA) is conceived and simulated in this paper. The antenna isfed from the midpoint at a distance from the grounded end. The design of the antenna is shorter and more compact, and the designer can control the matching impedance without the need for international matching components. The Evaluation of header model is simulated using the ANSYS HFSS and this organization results in with and without ferrite sheet Attachment based on Specific Absorption Rate (SAR) is 0.3261 W/ kg

REFERENCES

[1] Repacholi, M. H. (2001). "*Health risks from the usage of mobile phones".* Toxicology Letters, 10(6), 16–20.

[2] Hossain, M. I., Faruque, M. R. I., & Islam, M. T. (2015). "*Analysis on the effects of the distances and between human head and mobile phone on SAR*," Progress in Molecular Biology and Biophysics, 119(2), 103–110.

[3] Faruque, M. R. I., Husni, N. A., Islam, M. T., & Misran, N, "*Effects of mobile phone radiation onto human head with variation of holding tilt* positions," 2014, Journal of Applied Research and Technology, 12(5), 871–876.

[4] Matin, A.M, "Wideband, multiband, and smart reconfigurable antennas for modern wireless communication," 2015, Media & Communication Books, part of the Research Essentials Collection.

[5] Asadallah, F. A., Costantine, J., & Tawk, Y, "A Multiband compact reconfigurable PIFA based on nested slots," 2018, IEEE Antennas and Wireless Propagation Letters, 331–334.

[6] Loutridis, A., Yang, K., John, M., & Ammann, M.J, "A dual band 450LTE/GSM900 PIFA for portable devices," 2016, IEEE Loughborough antennas and propagation conference.

[7] Zhao, K., Zhang, S., Ying, Z., Bolin, T., & He, S, ”SAR study of different MIMO antennas forLTE application in smart mobile Handsets,” 2013, IEEE Antennas and Propagations.

[8] Naser, A.A., Sayidmarie, K.H., & Aziz, J.S,” Design and implementation of a PIFA antenna formulti-band LTE handsets,” 2016,IEEE Loughborough antennas and propagation conference.