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Rectangular Microstrip Patch Antenna for Medical Applications

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ABSTRACT: In this paper microstrip patch antenna is presented for biomedical applications. This antenna resonates at two bands having center frequencies 403 MHz, and 720 MHz. The proposed microstrip antenna has rectangular structure having microstrip feed. Roger having dielectric constant 10.2 is used as substrate material. The structure is simulated using IE3D. Simulation result shows that it covers two bands having centre frequency of 403MHz and 720MHz. Microstrip patch antenna is preferred as it is flexible in shape, conformal and miniaturization can be achieved to a great extent.

KEYWORDS: Antenna, MICS band, microstrip antenna, biomedical application

I.INTRODUCTION

Implantable medical devices are used to perform a wide variety of diagnostic and therapeutic function. With the help of biotelemetry and integrated implantable antenna full duplex communication is made possible between implantable antennas with on body receiver antennas for in-body communication system. Also wireless communication makes inroads into every aspect of human life. Designing an antenna for implanted application is difficult because of different electrical properties of human tissue. Also size of antenna at low frequency is a very crucial factor. Implantable medical devices can communicate wirelessly with an external device. Biomedical telemetry can be both real time and stored physical signals can also be communicated to the receiver. As per the commendation of FCC, Medical Implant communication Services (MICS) band of 402-406 MHz is recommended for implantable antennas. MICS band has replaced previous low frequency inductive link, which suffers from slow data rate, short range communication. The maximum transmit power requirement at this band is very low, about 25 microwatt. This reduces the risk of interference with other users of the same band. The maximum used bandwidth at a time is 300 KHz, which makes it a low bit rate system compared with Wi-Fi or Bluetooth. Implanted devices are inserted into human body and implantable antenna ensures wireless bio-telemetry. Therefore the antenna design is very crucial part in implantable device. Microstrip patch antenna is preferred as it is a narrowband, wide-beam antenna. These are fabricated by etching the antenna element pattern in metal trace bonded to an insulating dielectric substrate, such as a printed circuit board, with a continuous metal layer bonded to the opposite side of the substrate which forms a ground plane. Ground plane acts as reflector for radiation or it prevents radiation towards human body.
Common microstrip antennas are designed in shapes like square, rectangular, circular and elliptical, but any continuous shape is possible. Some patch antennas do not use a dielectric substrate, instead they are made of a metal patch mounted above a ground plane using dielectric spacers; the resulting structure is less rugged but has a wider bandwidth.

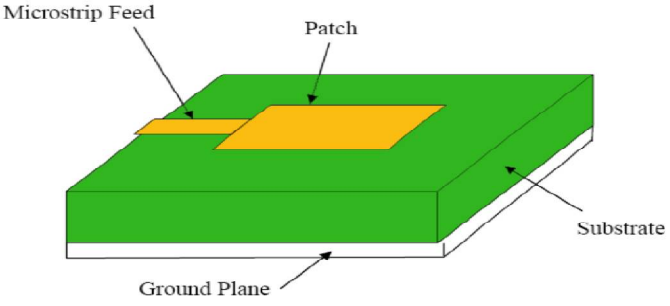

Fig 1.Microstrip patch antenna

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II.RELATED WORKS

In [1], a novel design of an IBSN operating in MICS band is being discussed. The major design challenges including the choices of wireless communication, the powering mode, and the system-on-a-chip (SoC) network node design are discussed in detail. In addition, the in-body electromagnetic field (EMF) exposure caused by the implanted RF antenna was modelled and simulated using computer simulation technology (CST) microwave studio software. By taking the cutting edge ultralow- power SoC design and adopting the newly available Zarlink MICS transceiver, this system innovatively incorporates both sensing and actuation nodes to form a closed-control loop for physiological monitoring and drug delivery for critically ill patients. This system not only attains low power consumption but also achieves low in vivo EMF exposure.

In [2] the basic knowledge of a fractal antenna is being discussed. How the fractal antenna is being constructed in MICS band. The self-similar fractal structures are constructed by scaling a rectangle. The performance of the prototype run in this paper was being tested using rabbit processor GSM module by detaching the dipole antenna, and the prototype model was attached, the patient health records such as body temperature, pulse and respiration were collected through modules and transmitted through the prototype.

The work in [3] presents the design and realization procedure of small implantable antenna for bio-telemetry applications. In this paper miniaturization techniques such as dielectric loading are being discussed which decreases the dimensions of the antenna, while maintaining the adequate of the electromagnetic performance. The implantable antenna was being tested on a homogenous body phantom which has a muscle like properties.

In [4], resonance characteristics of the implanted antennas and their radiation performance outside the body are studied to provide useful background information for hyperthermia and biotelemetry. Electromagnetic (EM) characteristics of the antenna implanted in a human head was analysed using two numerical codes: spherical dyadic Green's function (DGF) and finite difference time domain (FDTD). Since this study is related to biomedical applications, implanted antennas are assumed to operate in the frequency band (402–405 MHz) i.e. MICS band.The purpose of using antennas in a Bio-Implant can be either for telecommunication or therapy. In the former case, information is transmitted into or out of the host body (telemetry), in the second the antennas are used to provide energy, as in hyperthermia for instance. In this work, essentially antennas for telemetry are being considered. In telemetry applications, the system should transmit data over a certain distance, and features like radiation efficiency and bandwidth are essential to provide transmission over a large enough range with a high enough data rate.

In [5], an implantable rectangular spiral antenna is being for medical biotelemetry in the medical implant communications service (MICS) band (402 to 405 MHz). The designed antenna has a U-shaped loop for impedance matching. Significant design parameters were also studied to understand their effects on the antenna performance. To verify the potentials of the antenna for the desired applications, a prototype is being fabricated and its performance being measured in terms of the resonant characteristics and gain radiation patterns.

III. PROPOSED ANTENNA STRUCTURE AND SIMULATED RESULT

Implantable medical devices can communicate wirelessly with an external device. Designing an antenna for implantable medical devices is very critical. Size of antenna must be very small. Many research works is going on around the globe on the size reduction of the antenna at the MICS frequency band. Most of the available structures are complex (like spiral, helical, rectangular spiral, and fractal) and inherently very difficult to design and implement. Complex mathematical calculations are involved in analyzing these structures. In this paper we propose a microstrip rectangular patch antenna. The structure has been simulated in IE3D. The substrate material used is Roger having dielectric constant of 10.2, with a substrate height of 1.6mm. In the proposed antenna ground plane used is 250 X 250mm^2 and the patch dimension is 200 X 200mm^2. The simulation result shows that the antenna covers MICS band of center frequency of 403 MHz with an additional band having center frequency 720MHz.

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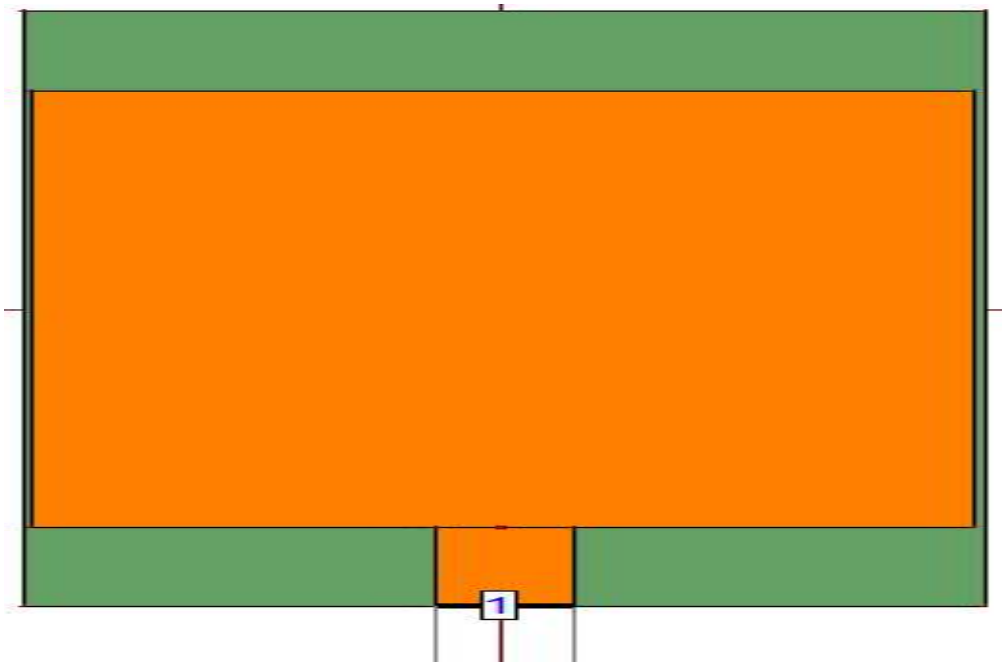

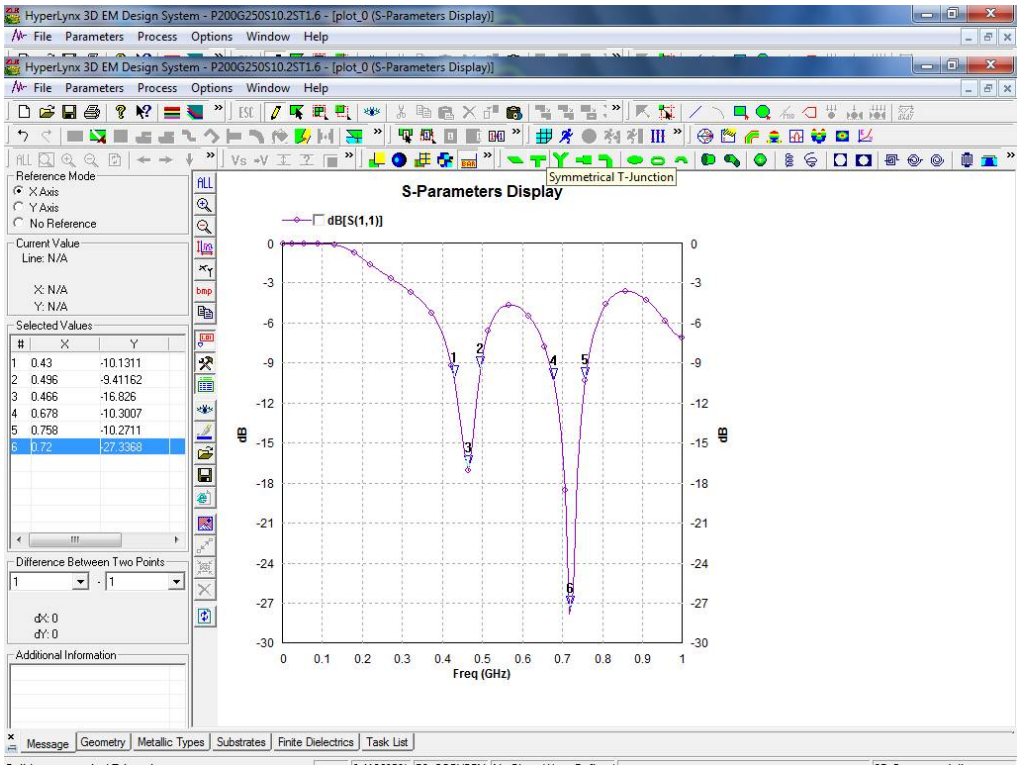

IV.CONCLUSION

Microstrip patch antenna is simple to design and implement due to its sensitivity at high gain but it is difficult to design it in MICS band. However, Microstrip patch antennas give high directivity, high gain and antenna efficiency. This

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antenna design can be very helpful in the communication system for many applications in fields such as biomedical example- pacemaker. The demand for narrowband antenna is increasing day by day. To meet with these increasing demands, more efficient antennas such as Microstrip patch antennas are required.

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