International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 07 Issue: 08 | Aug 2020 www.irjet.net p-ISSN: 2395-0072

Wideband Circularly Polarized Implantable Patch Antenna for Medical Applications

Dr.G.Mohan Babu[1], T.Deepa[2], R. Deva Shruthi[3], K.Hemalatha[4]

[1]*Associate Professor, Department of Electronics and Communication, SSM Institute of Engineering and Technology, Dindigul.*

[2, 3, 4] *Undergraduate student, Department of Electronics and Communication, SSM Institute of Engineering and Technology, Dindigul.*

Abstract - *In this paper, an antenna which can be used for medical applications to satisfy specific needs is designed. Under the light of recent discoveries in the field of medical imaging, proposed antenna is optimized and simulated with the aim of contributing the field of research depending on the parameter requirements. Antennas for medical applications are required for patient's health monitoring. The designed implantable antenna is proposed and the VSWR, Radiation pattern are observed and also compared the results at different Dielectric material. In this, copper is used as the patch material. The special features of this antenna are suitable for implantation and patient safety and that was implanted into the human tissue. The design of this antenna has gained considerable attention for dealing with issues related to biocompatibility, miniaturization, patient's safety and improved quality of communication with monitoring equipment. SAR value is chosen correctly to ensure this antenna is reliable for biotelemetry systems.*

Keywords: Antenna, Medical Applications, Monitoring based system, Good VSWR, SAR.

1. INTRODUCTION

An Antenna is an array of conductors, electrically connected to the transmitter or receiver. Antennas can be designed to transmit and receive radio waves in all horizontal directions equally or preferentially in particular direction.

Antennas are often as classified as omnidirectional, radiating energy approximately, equally in all directions, or directional, where energy radiates more along one direction than others.

Antenna arrays:

Antenna arrays are used to increase the directivity and gain in desired directions and eliminate the radiation in undesired direction. They are generally any combination of array and usually equal elements of regular geometry are used. Often it is impossible to generate a desired antenna pattern with just one antenna. An antenna array usually consists of multiple antennas collaborating to synthesize radiation characteristics not available on a single antenna. They are able, to match the radiation pattern to desired coverage area, to vary the radiation pattern electronically through the control of the phase and the amplitude of the signal fed to every element, to adapt to changing signal conditions, to extend transmission capacity by better use of the radio resources and reducing interference.

A patch antenna is a type of radio antenna with a low profile, which may be mounted on a flat surface. It consists of a flat rectangular sheet or "Patch" of metal, mounted over a larger sheet of metal called a Ground plane. The patch antenna is especially practical at microwave frequencies, at which wavelengths are short enough that the patches are conveniently small.

It is widely used in portable wireless devices because of the ease fabricating it on printed circuit boards.

Multiple patch antennas on the same substrate called microstrip antennas, and phased arrays in which the beam can be electronically steered.

An Implantable patch antenna is always used in short-range biomedical applications. The design of implantable patch antenna mainly emphasizes Miniaturization and Biocompatibility.

Conserving energy to extend the life span of the implantable medical device is additionally significant. ISM band antennas are being designed for these purposes that 'wake up' the implantable medical device only when there is a requirement for information exchange. The implantable antenna is operating in Industrial, scientific and Medical (ISM)(2.4GHz – 2.48GHz) bands.

Antennas are often implanted into human bodies or are often just mounted over the torso (Skin-fat-muscle) to form a bio-communication system between medical devices and exterior instruments for short range biotelemetry applications. Remote monitoring systems facilitate the diagnosis of disease and favor the hospital at home by reducing the hospitalization period.

Polarization is a property applying to transverse waves that specifies the geometrical orientation of the oscillations. In general, Transforming unpolarized light into polarized light.

Methods to achieve polarization:

Reflection, Scattering, Dichroism and Birefringence

Major applications of polarization are Polaroid glasses, Photographic filters, LCDs, Retinal Diagnosis, Intra-Ocular lenses, 3D films.

Linear polarization: In this type of polarization, Electric field vector oscillates along a straight line on one plane. The two orthogonal components are in phase so that the ratio of the strengths of components is constant.

Elliptical Polarization: Electric vector describes an ellipse about the direction of propagation and is equivalent to two planes polarized of unequal magnitude and Vibration in an elliptical path.

Circular Polarization: In type of polarization consists of perpendicular plane waves with equal amplitude and 90º phase difference and vibration in circular path.

Reason why Circular polariztion is used than Linear polarization in Medical antennas : A circularly-polarized(CP) antenna is preffered for the implantable devices because it can reduce multipath distortion and provide flexible mobility, compared with a linearly polarized antenna.

HFSS may be a commercial finite element method solver for electromagnetic structures from Ansys. The acronym originally stood for High Frequency Structural Simulator. It is one of several commercial tools used for antenna design, and the design of complex RF electronic circuit elements including filters, transmission lines, and packaging.

It integrates simulation, visualization, solid modeling, and automation in a simple to learn environment where solutions to your 3D EM problems are quickly and accurately obtained. Ansys HFSS can be used to calculate parameters such as S-Parameters, Resonant Frequency, and Fields. The finite element method (FEM) is the most generally used method for solving problems of engineering models.

The finite element method formulation of a boundary value problem finally results in a system of algebraic equations and the simple equations are combined to model entire problem and these equations are solved. Biomedical Engineering today holds a prominent place as a means of improving diagnosis and treatment. Today glucose monitoring, insulin pumps, deep brain simulations and endoscopy are a few examples of the medical applications which will cash in of body implantable unit.

Body implantable devices are widely researched for humans, in the applications such as monitoring blood pressure and temperature, tracking dependent people, wirelessly transferring diagnostic information from a device implanted in the human body for human care and safety.

The role of implanted antenna in diagnosis includes a wide range of applications, such as magnetic resonance imagind(MRI). In MRI, the antenna transmits electro magentic vibration in the human body, and as a feedback, it receives the nuclear magnetic resonant frequency signal radiated from the nuclei that create the human body.

The role of implanted antenna in treatment includes a pacemaker that monitor and control heart beat, and swallow-able capsule with sensing facility.

An antenna is integrated inside the human body by surgical means are put on the human body(wearable), depending on the needed applications; however, the human body around the antenna changes its overall characteristics and absorbs most of its radiation. Components work to sense the bio-signals,convert them into electrical signals, which are transmitted wirelessly through the antenna. For implantable antennas some of the design requirements which should be met are miniaturization in size, wider bandwidth, Biocompatibility, allowable SAR, Flexibility and so forth. Many aspects must be studied to ensure full implanted communication system, such as the receiver and its sensitivity, the scattering due to surrounded objects and its effect on the path of propagation of the radiated EM waves, in addition to the power needed for the implanted antenna, which usually requires the largest size in implantable device.

Generally, implanted antennas play a crucial role in transmitting biological signals to remote health care centers so that the patents can receive proper treatment at right time.

2. EXPERIMENTAL

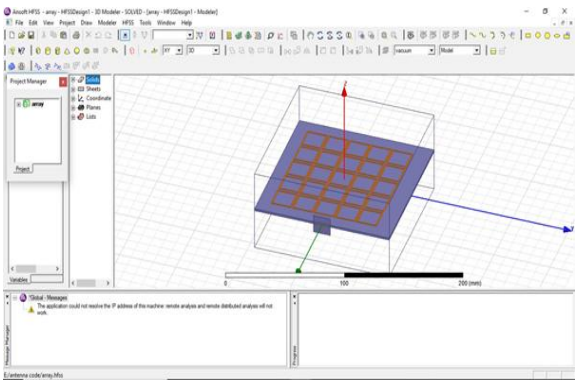

Figure 1: **Proposed Antenna Design**

In this paper, 5x5 Microstrip patch antenna array is designed to operate at multiple frequencies suitable for medical applications.

3. RESULTS AND DISCUSSION

Radiation Pattern gives the directivity of the antenna in 3-Dimension

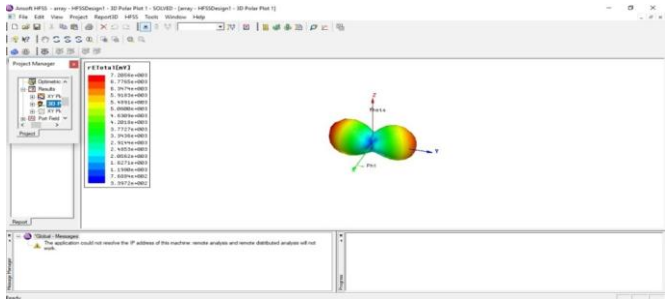

Figure 2: Radiation Pattern of Proposed system

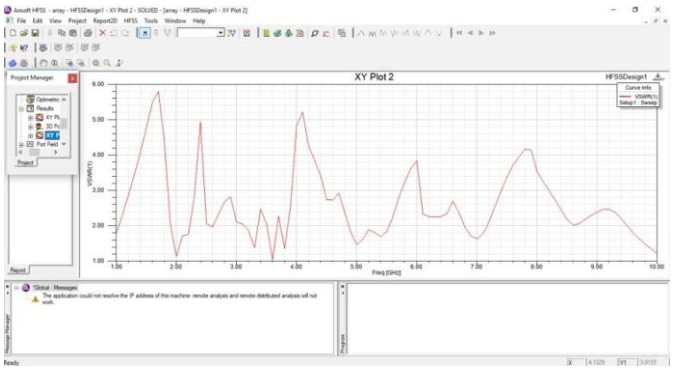

Figure 3: Relation between VSWR and Frequency

Gain is the important parameter of an antenna to determine the antenna's performance.

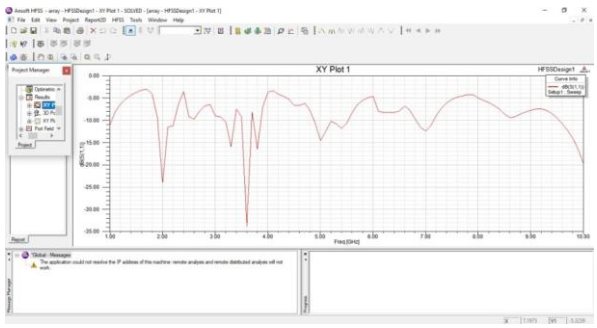

Figure 4: Relation between gain and Frequency

4. CONCLUSIONS

In the proposed work, the design of patches are carried out and placed in the 3D surface to analyze the radiation pattern, VSWR and Gain and SAR value for Medical applications. The input is the 5x5 patch array antenna.

By choosing appropriate substrate and dimensions for the patches and feed, the antenna is made suitable for medical applications. Majority of WLANs uses 2.4GHz band. For multiband applications, rectangular patches are used to make array small and lightweight. This comes at low cost and operating at various frequency levels.

REFERENCES

[1] Zhan Xia , Hua Li, Zongze Lee, Shaoqiu Xiao, Wei Shao, Xiao Ding, and xuesong Yang, "A Wideband Circularly polarized Implantable Patch Antenna for ISM Band Biomedical Applications", IEEE Trans. On Antennas and Propagation, Vol.68, 2020

[2] Abdullah J.Alazeni, Mohamed Waly, Ridha Ghayoula, Amor Smida, "Wideband Wearable Antenna for Biomedical Telemetry Application," IEEE Access, Vol.8, 2020

[3] Albert Sabban, "Small Wearable antennas for wireless Communication and Medical Systems," IEEE, 2018

[4] Zhi-Jie Yang, Lei Zhu, Shaoqiu Xiao, "An Implantable Wideband Circularly Polarized Microstrip Patch Antenna Via Two Pairs of Degenerate nodes," IEEE Access,

[5] Nithyanandham Ganeshwaran, Jegadishkumar Kailairajan Jeyaprakash, Mohammed Gulam Nabi Alsath, Vidhyashree Sathyanarayanan, "Design of Dual Band Circular Implantable Antenna for Biomedical Applications," IEEE Trans. On Antennas and Wireless Propagation, 2019

[6] Roy B.V.B Simorangkir, Yang Yang, "Dual Band Dual Mode Textile Antenna," IEEE Trans. On Antenna and Wireless Propagation, Vol.16, 2017

[7] R.Adeline Mellita, D.S.Chandu, "Novel Approach for Enhanced Reduction of SAR," International Conference on Signal Processing and Communications, 2018

[8] Lijie Xu, Jinpeng Xu, Zhaojun Chu, Shuo Liu, Xiaowei Zhu, "Circularly Polarized Implantable Antenna with Improved Impedance Matching, " IEEE Trans. on Antennas and Wireless Propagation Letters, 2020.

[9] Albert Sabban, "Small New Wearable Antenna for IOT, Medical and Sport Applications," 13th European Conference, 2019

[10] Ansys High Frequency Structure Simulator, http/www.ansys.com.