International Journal of Electrical & Electronics Research (IJEER)
Volume 4, Issue 2, Pages 46-48, June 2016, ISSN: 2347-470X

Designing of Meandered Antenna for Biomedical Application

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Abstract **–** A spiral meandered antenna is designed, simulated and presented in this research paper. After a keen literature survey it has found that the operating range for the biomedical application is 0.4 to 1.5GHz. In this range 0.402 to 0.405GHz is fixed for the medical implant and 1 to 1.5GHz is the range for breast cancer treatment. Hyperthermia is a major technique to cure breast cancer; it is used to enhance the temperature of cancerous cell with the help of microstrip antennas. Meandered antenna is small in size and having a better return loss than other comparative microstrip antennas.

Keywords **–** IMD, Biomedical telemetry, MPA, Biomedical Applications.

1. INTRODUCTION

During the last decades, biomedical engineering has been experiencing a tremendous growth. Many diseases which were not curable before are being treated by using microwave frequencies. Microstrip antennas have become a major setback in biomedical applications. Whether is a detection of cancer [1], treatment of cancer [4], microstrip antennas are satisfying every requirement. Biomedical telemetry permits the measurement of physiological signals at a distance [2]. The development of implantable medical devices (IMDs) is one of the most important aspects towards establishing such an advanced healthcare system.

Breast cancer is a common type of cancer which actually originates from breast tissue, basically from the inner lining of milk ducts or the lobules. Recently awareness about the breast cancer has been increased and so does its treatment and detection methods. Some of the techniques to prevent from the cancer are surgery, radiation or immunotherapy. Even though the above techniques have been implemented there are some drawbacks which are to be overcome.

In hyperthermia treatment, temperature of certain part of body or more specifically the part where cancerous cells are located is increased by using microwave frequencies. The range of temperature is 42-45 °C as this is shown very effective in treating cancers along with the combination of radiotherapy and chemotherapy. Some tumors are located close to the surface of the body and other cancerous cells which are located near the surface of the body can be treated by applying electromagnetic field energy through external microstrip radiators.

Microstrip patch antennas has become a big role in wireless communication systems due to its wonderful properties such as less weight, very much comfortable to irregular surfaces, economic, low profile and simple.

In this paper an spiral meandered antennas is proposed which is small in size as compared to the standard patch antenna for this operating frequency of 1.5GHz.

2. METHODOLOGY

For breast cancer treatment the frequency range is 1 to 1.5GHz, therefore this proposed antenna is designed for the same frequency band. This spiral meandered antenna is designed over the 50X50mm base and substrate. Substrate is having the height of 1.59mm and dielectric constant of 4.4.

The top view of spiral meandered antenna is shown in figure.

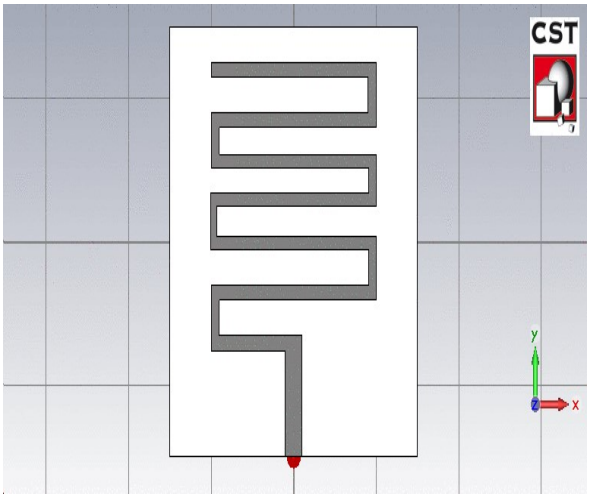

Figure l. Back and front side of the proposed antenna, inspired by meandered antenna.

This proposed design is inspired by spiral meandered antenna.

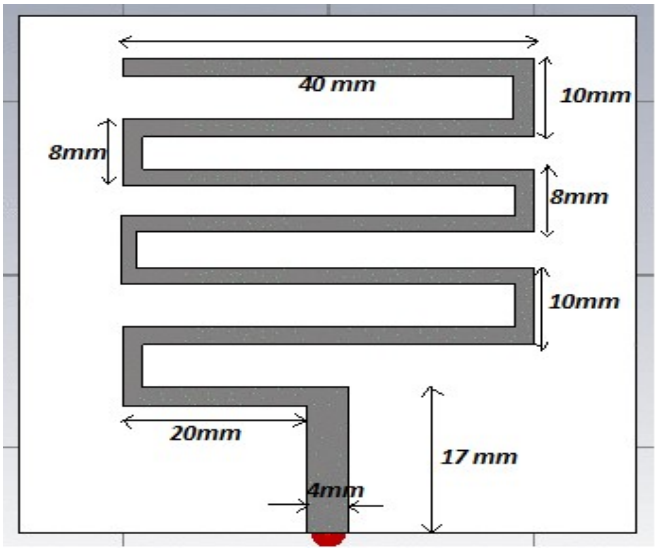

Figure 2. Showing dimensions of the meandered antenna

The proposed antenna composes two planar layers with the same substrate. On top there is a spiral shaped structure shown in figure 1 with its dimension in figure 2. The structure is a meandered line connected with the stripline of 50 Ohm line impedance. Benefiting from the meandered radiator with plane ground, the bandwidth and the size of the antenna are improved, since the electric length of the structure is increased. The radiation efficiency of the antenna is increased by using stripline feed, because the radiation along the feed line is prevented, compared to the microstrip line or coplanar waveguide surrounding with a lossy medium, in which the radiation efficiency is reduced due to the presence of the surface- and fringing waves.
Following is the simulated result of the proposed antenna.

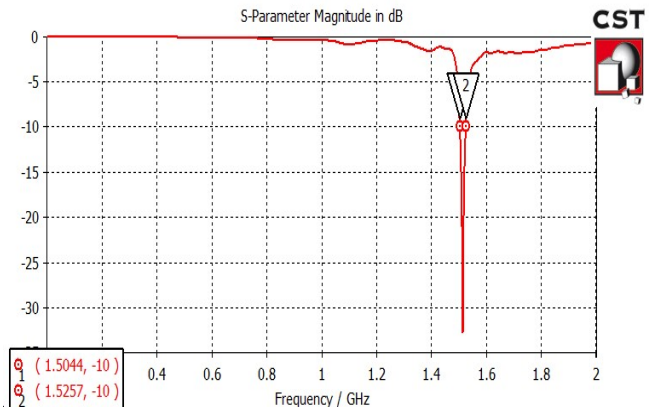

Figure 2. Result of antenna shown in fig 1 having return loss of -32 dB and bandwidth of 21MHz

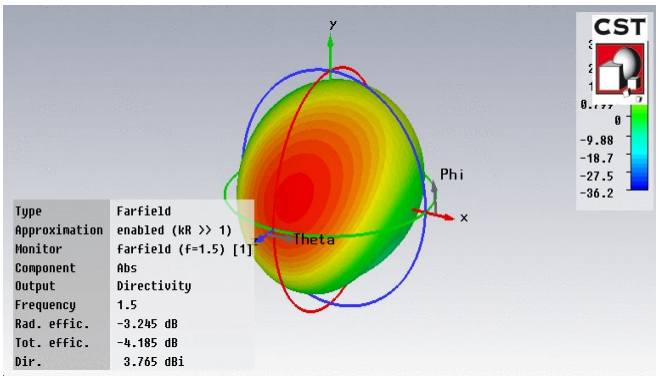

Figure 3. Radiation pattern of the simulated patch antenna

Results of the proposed meandered antenna shows the directivity nearly equal to 4 and showing efficiency nearly equal to 50% along with this the return loss of the proposed design showing the return loss of -32dB, which is sufficient enough to treat breast cancer by increasing body temperature using microwave frequencies.

3. CONCLUSION

A miniaturized single band spiral shaped meandered antenna is presented. The main radiator having a spiral shaped structure with its dimension showing in figure 2 is implemented over a plane ground and substrate having its height of 1.6mm. This proposed antenna could be used in treating and detecting cancer tumors if used in imaging techniques with some modification. This antenna can also be designed for MICS (Medical Implant Communication Service) band which has the range of 402 to 405MHz. athat could be used as a implant device, but in this research the main focus was to design an antenna for breast cancer imaging and for the hyperthermia. The antenna will be crafted and further analyses will be done to understand its capabilities in a realistic case.

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