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# Designing Issues of Microstrip Patch Antenna in Biomedical Field: A Review

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**ABSTRACT:** Remote Malignant tumor diagnostics plays a significant role in the ability of contemporary medicine to treat cancer illnesses because early stage cancer can be treated successfully by well-developed conventional techniques. Various techniques have been used so far to design such antennas for different type of diseases. This review paper is an output of a detailed survey of various available techniques. The objective of this paper is to provide an overview of these challenges, and discuss the ways in which they have been dealt with so far in the literature.

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

## 1. INTRODUCTION

Technology modifies each day by a large group of thinkers and researchers of engineering expeditiously. Every aspect of life is greatly affected by it. Human live is getting easier everyday due to new advancements done by the people of science. Especially, when the main interest of a research topic is human life, the topic becomes relatively popular. When engineering is projected on biology and human life, the result becomes medical electronics, which might be one of the popular subjects of research due to its main interest: Human body.

Especially in the area of cancer imaging, scientists work of numerous proposals about the imaging problem and keep discovering new features about solving one of the most deadly diseases in the world.

Hyperthermia is a way to treat cancer tissues with enhancing the temperature of a part of the body within the range 42-45 °C. This technique has been shown to be an effective treatment for some cancers in combination with radiotherapy and chemotherapy. For treatment of tumors which are located close to the surface of the body, the electromagnetic field energy is applied through external antennas (applicators) [1], [2], [3].

Instead of treating any disease, prevention is far better option. Millions of people worldwide depend upon implantable medical devices to support and improve the quality of their lives.

Until recently, no globally accepted frequency band had been dedicated to biotelemetry for implantable medical devices. The situation changed with the ITU-R RecommendationSA.1346 [10], which outlined the use of the 402.0-405.0 MHz frequency band for Medical Implant Communications Systems (MICS).

However, focus is on the MICS band, because of its advantages of being available worldwide and being feasible with low-power and low-cost circuits, reliably supporting high-data-rate transmissions, falling within a relatively low-noise portion of the spectrum, lending itself to small antenna designs, and acceptably propagating through human tissue.

## 2. TECHNIQUES USED TO DESIGN BIOMEDICAL ANTENNS

### 2.1 inspired by the geometry of the Yagi-Uda

The front side of the antenna has a feed line with changing width which is connected to the main radiating strip. With a parallel yet shifted strip above the main radiator, the frequency is arranged. The ground side of the antenna mirrors the radiating frontal side, roughly. The width and lengths of the antenna were optimized by using CST software to achieve the best possible option.

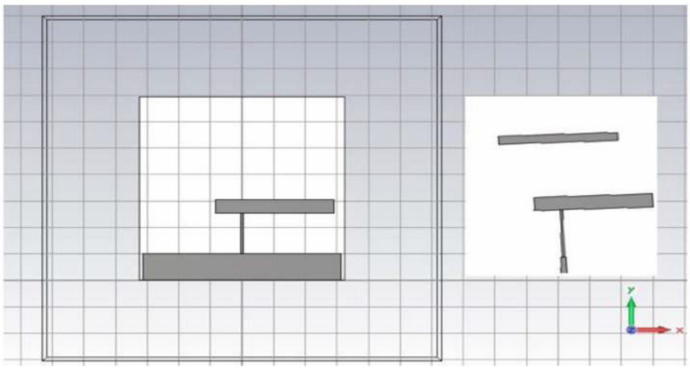

Figure l: Back and front side of the proposed antenna.

### 2.2 Metasurface-Enabled Antenna

This antenna is comprised of two components separated by a thin foam spacer—a planar monopole on the top and on the bottom a custom-designed highly truncated anisotropic metasurface with a metallic sheet backing. The top planar monopole is fed by a microstrip while the metasurface layer contains an array of two by two I-shaped elements. The monopole is oriented parallel to the long axis of the I-shaped elements for an efficient excitation.

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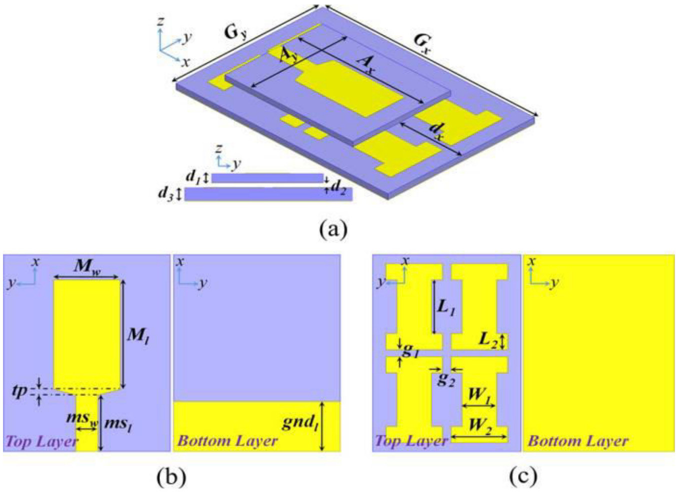


**Figure 2: (a) Configuration of the integrated planar antenna. (b) Top and bottom views of the top monopole layer. (c) Top and bottom views of the finite sized metasurface layer with a metallic backing.**

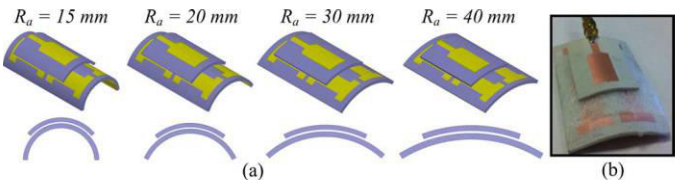


**Figure 3: (a) Structurally deformed integrated metasurface-enabled antenna withdifferent values of the radius of curvature ranging from 15 mm to40 mm. (b) A photograph of the deformed antenna with a radius of 40 mm.**

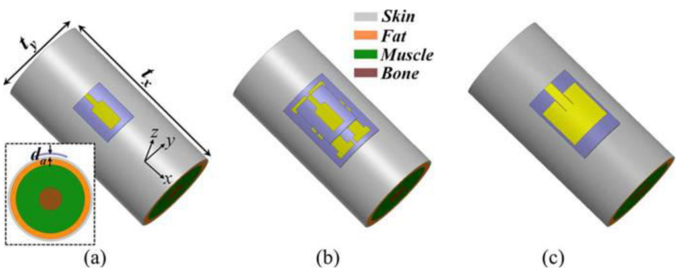


**Figure 4: Structurally deformed (a) monopole antenna, (b) integrated metasurface-enabled antenna, and (c) reference patch antenna when placed on a cylindrical multilayer tissue model representing human arms.**

## 2.3 Capacitive Loaded Antenna

A compact implantable CP patch antenna with capacitive loading to achieve better impedance matching and capacitive coupling for effective size reduction was proposed.Microstrip patch antenna with a center square-slot, which is an initial configuration and starting point of the proposed antenna. Then a compact capacitive loaded CP was implantable patch antenna based on the study of the initial configuration that the patch antenna would have good size reduction and good impedance matching with the suitable size of a center square slot.

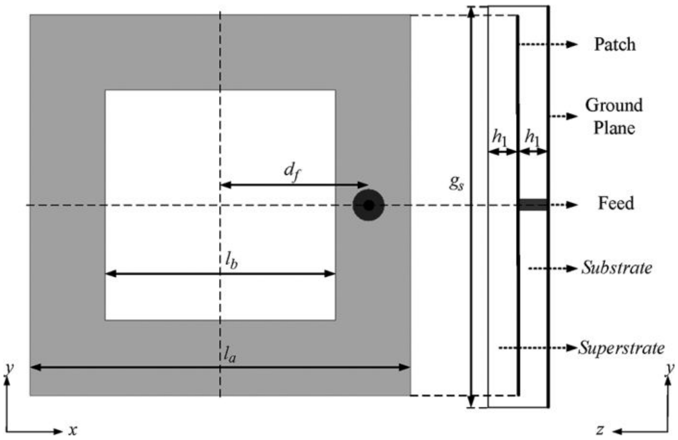


**Figure 5: Geometry of an implantable patch antenna with a center square slot.**

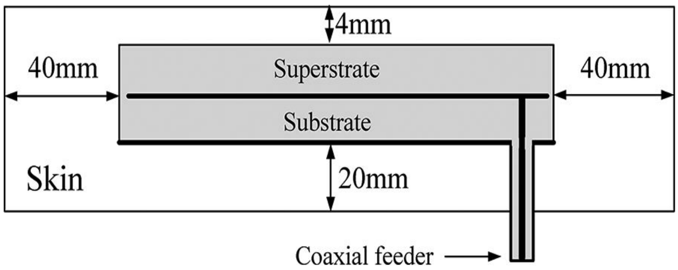


**Figure 6: Cubic skin phantom geometry for the design of an implantable antenna.**

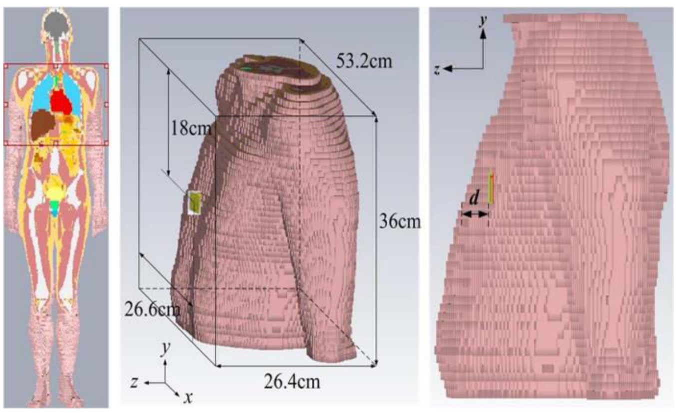


**Figure 7: The 3D Gustav voxel human body used for the implantable antenna design in a human chest.**

## 2.4 Circular Micro strip Antenna

A two conducting patches stacked on top of each other, but separated by a substrate with a radius of 2.5 mm and a height of 0.25 mm. Both patches have the same radius (2.4375 mm), and they are slotted in circular patterns with 8 slots in each, but with a different arrangement the lower patch is grounded with a shorting pin with a radius of 0.15 mm. stacking, slotting, and shortening the conducting patch are ways to lengthen the current-flow path, resulting in a significant reduction in size.

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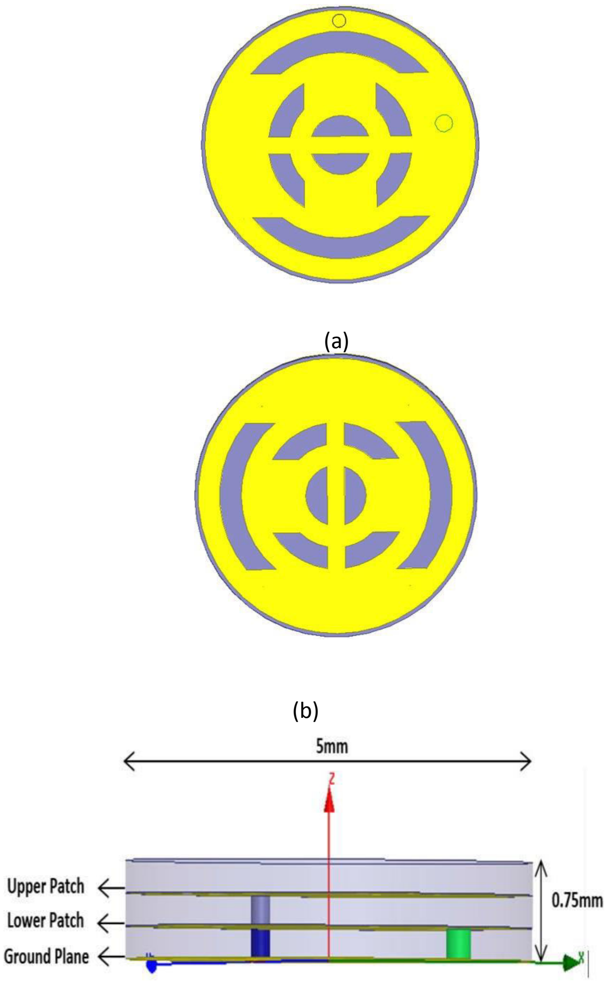


(c)

**Figure 8: The proposed antenna design: (a) Lower patch including shorting pin, (b) Upper patch, and (c) Side view.**

## Table I: Comparison Chart

| S. no. | Modification Techniques | Configuration | Remarks |
|---|---|---|---|
| 1 | INSPIRED BY THE GEOMETRY OF THE YAGI-UDA | The front side of the antenna has a feed line with changing width which is connected to the main radiating strip. With a parallel yet shifted strip above the main radiator, the frequency is arranged. | The proposed antenna has advantages like wide angular width and small size which makes it realizable for the proposed job. |
| 2 | METASURFACE-ENABLED ANTENNA | It is comprised of two components separated by a thin foam spacer | The antenna is robust to structural deformation and loading effects of human tissue, as well as possible impact of environmental variation. The metallic sheet backed metasurface also greatly reduces the maximum 1g averaged SAR value. |
| 3 | CAPACITIVELY LOADED ANTENNA | was designed on a two-layer Rogers 3010 substrate with dielectric constant of 10.2, | Antenna was designed and proposed at the frequency of 1 GHz with -20dB return loss. |
| 4 | CIRCULAR MICROSTRIP ANTENNA | The proposed antenna has two conducting patches stacked on top of each other | An implantable miniaturized circular microstrip antenna design was presented to resonate at a frequency in the ISM band for biomedical telemetry applications. |

After the comparison it has been observed that yagi uda based technique is the best technique to design such kind of antenna that are more suitable for biomedical application in the treatment of the cancer by using hyperthermia.

## 3. CONCLUSION

The embedded radiator within the hyperthermia applicator in this example has to be nearly the tissue to have minimum possible back loss and transmits the highest amount of energy into the tissue. However, the close proximity of the radiator to the tissue would lead to significant detuning of the radiator operating frequency. To design a antenna for such application will be a good benefit for the society and it is the need of the hour. As this techniques yields good results so this yagi uda based technique will be followed.

## REFERENCES

[1] C. A. Balanis, "Microstrip Antenna" in*Antenna Theory and Design,* Vol 3,John Wiley & Sons, Inc., 1997, pp. 811-882.

Date of Publication: 10 June 2017 | ID: IJEER-050211 |Volume 5, Issue 2 | Pages: 37-40

[2] Houda Halheit, Rachida Touhami et al., “Effect of Microstrip Rectangular Radiator Width on SAR for Local Hyperthermia,” in IEEE Antennas and Wireless Propagation Letters, 2014.

[3] R. LEDEE, M. CHIVE, M. PLANCOT, “Microstrip microslot antennas for biomedical applications: frequency analysis of different parameters of this type of applicator,” in ELECTRONICS LETTERS 28th March 1985 Vol. 21 No. 7

[4] Md. Masudur Rahman, Md. Mozaffor Hossain, Kallol Krishna Karmakar, “Π-shape microstrip antenna design for WiMAX, Wi-Fi and biomedical application at 2.45 GHz,” in IEEE Proceedings, 2012.

[5] Robert Salama, Ranjith Liyanapathirana, Upul Gunawardana, “An Implantable Encased Microstrip Ring Rectenna for Wireless Biomedical Applications,” in IEEE Proceeding, 2013.

[6] Shashiketan Samal, Santanu Dwari, Ashudeb Dutta, S. Pradeep Reddy, “A Microstrip Patch Antenna for Biomedical Applications at 2.45 GHz,” 5th international conference on computer and devices on communication (CODEC), 2012.

[7] Raed M. Shubair, Amer Salah and Alaa K. Abbas, “Novel Implantable Miniaturized Circular Microstrip Antenna for Biomedical Telemetry,” in IEEE conference, 2015. [7] Monish Gupta, Jyoti Saxena "Superdirective patch Antenna Array UsingMetamaterial." IEEE Connect2014, pp. 1-6.

[8] R Bhadoriya et al, “Miniaturisation of WLAN feeler using media with a negative refractive index”. *BIJIT*, Vol.5, No.1, 2013.

[9] R. W. Ziolkowsky and E. Heyman, "Wave propagation in media havingnegative permittivity and permeability," Phys. Rev. E, vol. 64, p. 056 625,Oct.2001.

[10] Beaky, Matthew M., John B. Burk, Henry O. Everitt, Mansoor A. Haider, and Stephanos Venakides. "Twodimensional photonic crystal Fabry-Perot resonators with lossy dielectrics." Microwave Theory and Techniques, IEEE Transactions on 47, no. 11 (1999): 2085-2091.

[11] Michael Civeroloand Dean Arakaki, "Aperture Coupled Patch Antenna Design Methods," in APSURSI, IEEE Conference, 3-8 july 2011, pp. 876-879.

[12] Iman Ben Issa, Rachid Rian, and Mohamed Essaaidi, "Circularly Polarized Microstrip Patch AntennaGain Improvement Using New Left-HandedMetamaterial Structure," IEEE Trans, 2009.