

SURVEY ON MICROWAVE RADIOMETRIC TECHNIQUES IN MEDICAL APPLICATIONS

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ABSTARCT

Microwave imaging is an energetic wave-based non-invasive imaging technique. Non-ionizing magnetism waves from microwave signals area unit able to penetrate human tissues while not making health hazards. The distinction within the electrical properties between healthy and malignant tissues is that the principal of operation of microwave imaging systems. The applying of microwaves in drugs has recently obtained revived attention among the scientific community through rising techniques in carcinoma detection, tumor detection etc.. The paper is regarding discussing regarding the prevailing works on radiometry and proposing a replacement technique victimization microwave radiometry for sleuthing the diabetic foot ulcers.

KEYWORDS-Non-invasive, Microwave imaging

1. INTRODUCTION

.Microwave radiometry in clinical drugs aims at etymologizing data on internal vital sign patterns by mensuration of natural thermal electromagnetic radiation from tissue within the lower a part of the microwave region (<5GHZ). Data on such thermal patterns will offer valuable data in clinical illness detection and diagnosing furthermore as providing quantitative temperature feedback in observance of thermal therapeutic processes. The appliance of microwave radiometry raises many problems in determination of body covering temperature heterogeneities. Most vital is a way to optimize style of the receiver hardware by identification of mutual compatible microwave devices with sufficiently low noise figures.

Table.1. represents the comparison of radiometry with alternative techniques of imaging within the medical field. Which shows that it's higher in terms of price and hardware complexity.

Table.1.Comparison of some imaging methods.

Modality	Cost	Hardware complexity	Resolution
X-ray	Moderate	Moderate	High
PET	High	High	High
Gamma camera	Moderate	Moderate/High	Moderate
MRI	High	High	High
Ultrasound	Moderate	Moderate	Moderate
IR	Moderate	Moderate/High	High
Radiometry	Low	Low	Low

A)ADVANTAGE

- Wide range of frequencies.
- Ability to focus the energy.
- Variety of simulation tools.
- Relatively low cost.

B)LIMITATION

- Low spatial resolution.
- Complex patterns of fields in the body.

2. RELATED WORKS

In (1) the authors proposed an flexible antenna array for detecting the breast cancer .Here the concept of radiometry is used .Initially the microwave signal is generated using the microwave source and it is allowed to pass through the breast tissues and the radiated signal is allowed to measure by the designed flexible antenna array and finally the output is simulated .As the dielectric properties of the affected tissue and the normal tissues varies we could see the difference between the affected tissue and the normal tissue the difference is shown in the form of color variation.

In (2) the author planned associate degree automatic sighting technique to detect the diabetic foot with infrared diagnostic procedure exploitation uneven analysis technique. In diabetic foot the key symptom is that the hyperbolic plate like foot temperature that is that the major issue accustomed sight the

diabetic foot in this paper. Initially the image of the foot is captured by the IR camera with the assistance of that image, uneven analysis is being allotted that embody the subsequent steps

1. Foot segmentation: Extract the left and therefore the right feet from the background.
2. Feet registration: Register the 2 feet to associate areas of 1 foot with the corresponding areas of the contralateral foot.
3. Detection: Compare the temperature of the associated areas: if the distinction between the temperatures of 2 associated areas is larger than an explicit threshold, then one among these 2 areas is assumed to be in danger.

In (3) they planned a technique to sight Vesicoureteral reflux exploitation microwave radiometry wherever Vesicoureteral reflux (VUR) is associate degree abnormality within the piddle system that causes piddle within the bladder to flow backward to the urinary organ. A log spiral antenna is intended then the stuff, thermal properties and thickness of skin, fat, muscle, piddle and urinary organ is known and supported that the saline phantom is intended and warmth distribution is obtained from numerous study. When the complete setup the microwave signal is allowed to pass the phantom and therefore the mirrored signal is measured by the designed log spiral antenna and at last antennas numerous parameters area unit analyzed and compared to detection.

In (4) the authors planned a circular antenna array to sight the carcinoma. The antenna is formed circular in order that it will be directly moon-faced to the breast phantom for higher growth detection. The principle behind the microwave breast imaging (MBI) consists of a transmitter microwave signal to emit signals inward the breast and receivers to sight those emitted signals when they act with the breast. Within the presence of a growth, sometimes with higher stuff properties than those of the opposite tissues of the breast, the number of signal energy scattered by the growth is on top of the one scattered by the materials of a standard breast with no growth. In this paper, they conjointly planned associate degree inset-fed rectangular patch antenna for microwave imaging employing a two.45GHz signal. Conjointly the performance characteristics of 5 associate degree antennas operating within the same frequency vary is evaluated by inserting them on the breast skin to get an antenna that satisfies the look criteria for 3-D antenna array system for microwave breast imaging.

In (5) a pattern primarily based small strip antenna for respiratory organ growth detection and a phantom with and while not growth is planned. This planned antenna is intended and simulated over simulation technology (CST) microwave studio (MWS) that relies on finite integration technique. The planned antenna is simulated upon respiratory organ phantom with and while not growth singly and therefore the variations in current density, E-Field and H-field helps to search out the presence and therefore the absence of growth. The antenna contains a current density worth of 789 A/m² that is double than that of the respiratory organ while not growth, E-field of 2769V/m that is bigger than the respiratory organ having no growth and force field of ten.96 A/m that is bigger than the respiratory organ having no growth.

In (6) a microwave brain imaging system model is envisaged to sight and visualize growth within the human brain. A compact and economical microstrip patch antenna is employed within the imaging technique to transmit equivalent signal and receive backscattering signal from the stratified caput model. Magnetism band gap (EBG) structure is incorporated on the antenna ground plane to reinforce the performance. Rectangular and circular EBG structures area unit planned to analyze the antenna performance. Incorporation of circular EBG on the associate degree antenna ground plane provides an improvement of twenty-two.77% reciprocally loss, 5.84% in electric resistance information measure, and 16.53% in antenna gain with relation to the patch antenna with rectangular EBG. The simulation results obtained from civil time area unit compared there to obtain from HFSS to validate the look. Specific absorption rate (SAR) of the sculptural head tissue for the planned antenna is decided. Totally different SAR values area unit compared with the established customary SAR limit to produce a security regulation of the imaging system. A mono-static measuring instrument primarily based confocal microwave imaging algorithmic rule is applied to come up with the image of growth within a six layer caput phantom model. S-parameter signals obtained from circular EBG loaded patch antenna in numerous scanning modes area unit used within the imaging algorithmic rule to effectively manufacture a high resolution image that faithfully indicates the presence of growth within human brain.

In (7) the author presents a microstrip antenna designed on a versatile substrate which will be placed on the skin. Victimization the substrate parameters, an initial rectangular patch antenna was designed and simulated without any skin layer. A 1.5mm skin model was then accessorial on the highest of the antenna model. Within the next step, the microstrip antenna style was modified for an optimized operation with the skin layer on the highest. The simulation models of the antenna with and while not skin layer is completed. The look methodology of the antenna, analytical results victimization simulation models in Ansoft High Frequency Simulation Software (HFSS), and experimental results using an in-house breast phantom square measure given. The advantage is that the flexibility and therefore the ability to work in-tuned with the skin improve the efficiency and usefulness whereas reducing the shape issue and value. The given antenna in a very microwave breast imaging device will take away the necessity for coupling liquid medium and so allows the event of wearable breast imaging devices.

In (8) the author presents the physical construction and power deposition characteristics of interstitial microwave antennas that may be used for highly localized heating of tissue at depth in the human body. Several different antenna designs are described and matched with potential clinical applications that range from moderate temperature Hyperthermia therapy to tissue- necrosing Thermal Ablation therapy. Typical clinical procedures are outlined for thermal treatment of target sites such as brain, prostate, heart, and gynecologic region tissues. Associated methods of implanting the antennas and coupling microwave energy into the surrounding tissue are also described, including the use of single or multi-chamber stiff, flexible or inflatable balloon type catheters, with or without circulating air or water cooling. With numerous references to the primary literature,

this material should provide a framework for analyzing potential new applications for interstitial microwave antennas, as derived from the physical capabilities and limitations of the available hardware and techniques.

In this review paper (9), analysis progress on implantable antennas for wireless drugs devices is mentioned and summarized. Associate implantable antenna might be a key half for oftenest connected measurement as many challenges arise. Associate implantable antenna should meet requirements like compact size, operative system of measurement, comfy radiation efficiency, and patient safety. The aim of this paper is to administer a top level view of this progress and achievements and address the challenges for implantable antenna vogue. Firstly, the outline of the requirements related to the implantable antenna vogue is provided. Then simulation and take a glance at ways for implantable antenna vogue are examined. Fully totally different antenna varieties, operative frequency bands and elegance environments are reviewed. Paste your text here and click on "Next" to seem at this text redact do its issue.

In this paper (10), a review of implantable antennas for wireless medicine devices has been bestowed. The summary of the necessities associated with the implantable antenna style has been provided. Meanwhile, totally different types of miniaturized techniques and simulation and take a look at strategies for implantable antenna style are studied; antenna sorts, in operation frequency bands, safety issues, style environments, and testing strategies are reviewed. Finally, recent analysis topics on implantable antennas are introduced. In apply, several factors ought to be thought-about once implantable antennas square measure integrated with alternative medicine circuits or sensors as alternative parts might have an effect on the performance of the implantable antennas. Also, low power consumption could be a massive concern so as to increase the time period of the implantable devices and maintain the protection issues of patients. Antenna dimensions, radiation potency, battery life, communication distance, polarization then on ought to be thought-about as an entire to style implantable devices.

In (11) associate degree implantable volute coil microwave antenna has been developed for improved localization and management of opening physiological state for constituted tumors. A volute coil structure was utilized as associate degree extension of the inner conductor at the terminal portion of a miniature semi-rigid transmission line. The antennas were created with 3 totally different association configurations of the volute coil to the feed line, and with many coil flip densities throughout the optimization of heating characteristics. So as to check relative antenna heating performance, a group of quantitative parameters was introduced. Power deposition profiles of 2450 megacycle per second volute coil antennas were studied in each phantom models and muscle tissue in vivo, and compared to those of ordinarily used dipole antennas. Best antenna performance was obtained with a one0-turn per 1 cm volute coil connected to the inner conductor at the tip and separated from the outer conductor by a zero.1 cm gap (HCS-10). These antennas created a well-localized heating pattern with a pointy drop-off of temperature in each directions axially from the coil component. For half-wavelength insertion depths, the effective heating length (50 per cent of most SAR) of HCS-

10 antennas matched that of normal dipole antennas, however was shifted down towards the tip. For shorter and deeper antenna insertion depths the HCS-10 heating pattern remained equally localized to the region encompassing the volute coil with smallest cold zone at the tip. In distinction, the transmitting aerial heating pattern modified considerably counting on insertion depth, with associate degree ineluctable zero.2-0.7 cm cold region at the antenna tip and elevated surface temperatures for brief insertion depths.

In (12) a passive and noninvasive technique that's ready to live deep tissue temperature and track changes in thermal profiles in tissue up to five cm below the surface over many hours. These characteristics create microwave radiometry an appropriate technique to observe brain temperature throughout extended physiological state surgeries, and so avoid potential complications that result from poorly controlled temperature levels and come to physiological state. This chapter addresses all development stages of a radiometric brain measuring system including: meter electronics; antenna style and fabrication; power to temperature standardization algorithm; multilayer head phantom model with variable temperature compartments; experimental validation of detector performance; and initial clinical implementation. Specially, a radiometric antenna is represented supported a log-spiral style optimized in semiconductor to receive energy from deep brain. The image is tested employing a realistic head phantom that consists of associate anatomical human os with separate brain and scalp compartments within which tissue-equivalent fluid phantoms flow into a freelance temperatures (32 °C for scalp and 37 °C for brain). Experimental information shows that the calculated radiometric brain temperature tracks at intervals 0.4 °C the measured brain phantom temperature over a 4.6 h experiment, once the brain phantom is lowered 10 °C so came back to original temperature. A clinical case confirms the flexibility to noninvasively monitor temperature in deep brain victimization microwave radiometry, with radiometric measurements that closely track changes in core temperature as measured within the cavity. Each simulated and experimental results demonstrate that a 1.1–1.6 gigacycle per second radiometric detector with 2.5 cm diameter is associate applicable tool for noninvasive observation of deep brain temperature.

Table.2. compares the parameters, frequency and the dielectric values used in the discussed papers.

Ref no	Parameter Measured	Freq (HZ)	Dielectric Properties(ϵ_r)
[1]	Radiated EM energy	3G	Antenna substrate=3.4
[2]	Temperature variation	480M	-
[3]	Temperature variation	1.1-1.6G	Phantom=3
[4]	Radiated EM energy	2.4G	Healthy tissue=36 Skin=9 Tumor=50
[5]	Radiated EM energy	5.02G	Lung=2 Tumor=54.2

[6]	Radiated EM energy	0.29G	Brain=43.22 Tumor=55
[7]	Radiated EM energy	2.4G	Substrate=0.2 5 Skin=39
[8]	Temperature variation	3G	-
[9]	Temperature variation	401-406MHZ	Substrate=10. 2
[10]	Radiated EM energy	2.4G	Substrate=10. 2
[11]	Temperature variation	2.45G	Substrate =8.2
[12]	Temperature variation	1.1-1.6G	Substrate=6.1 5

[12]	Brain temperature monitoring	Implantable
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3. PROPOSED SYSTEM

There are two techniques to be used. In the thermal imaging technique the temperature analysis is done and using that the result is found and in the second technique initially the transmitter antenna transmits the microwave signal and then after the signal passes through the phantom the reflected signal is being measured to find the result. The frequency represents the covered bandwidth limit in the respective papers and the dielectric properties of these used substrate and phantom is represented.

Table.3. represents the application, the design used and the antenna position is mentioned. surface mounted in the sense it is externally mounted and the implantable antennas are implanted in the human body.

Table.3. compares the application and the antenna position used in the discussed papers.

Ref no	Application	Antenna position
[1]	Breast cancer detection	Surface mounted
[2]	Breast cancer detection	Surface mounted
[3]	Vesicoureteral urinary reflux	Surface mounted
[4]	Breast cancer detection	Surface mounted
[5]	Lung tumor	Surface mounted
[6]	Brain tumor	Surface mounted
[7]	Skin contact	Surface mounted
[8]	Monitor tissue temperature	Implantable
[9]	Biomedical applications	Implantable
[10]	Biomedical applications	Implantable
[11]	Biomedical applications	Implantable

Diabetic foot ulcers is because of poorly controlled polygenic disorder, as a result skin tissue breaks down and the layers beneath exposed. The planned system is to style a versatile antenna array and a phantom with and while not wound to observe the diabetic foot ulceration at the sooner stage that reduces the necessity for hospitalization additionally the use of antenna array helps in increasing the gain and also provides narrower beam. at the start the antenna with bound dimensions is intended so the nonconductor properties of a traditional leg and also the wound is known so consequently a phantom for with and while not wound is intended. When the completion of the planning method simulation is completed wherever the simulation is completed victimization HFSS. within the simulation method at the start the microwave signal is generated so it's allowed to suffer the phantom and also the mirrored signal is measured and by examination the output parameters E-field, H-field, current density, SAR the result's made.

Phantoms square measure characterized by essential electrical properties that square measure the relative permittivity (ϵ_r) and conduction (σ). Associate in nursing extended analysis has proved that there's a vital opposition between healthy and malignant tissue properties. The various electrical properties of the leg and wound square measure conferred in Table four.

Table.4. Dielectric properties

Tissues	Permittivity (ϵ_r)	Conductivity (σ)	Thickness
Skin	41.405	0.86674	1100
Fat	5.462	0.051043	1100
Bone	13.270	0.0869	1850
Wound	74.85	0.000956	2591

Assessment of specific absorption rate (SAR) induced inside human by microwave imaging is necessary as EM waves radiated from the transmitting antenna directly travel through the patients leg and significant portion of the radiated power carrying by EM waves is absorbed by leg tissues. These energy absorptions are not distributive in nature and may cause localized RF energy deposition in the form of nodes

and damages DNA of living tissues which may trigger cell suicide or unregulated cell division resulting in the formation of a cancer hence accurate analysis need to be done.

Fig.1.shows that Initially the signal get transmitted from the transmitter antenna and which is passed through the phantom and then the reflected signal is received by the receiver antenna which is amplified and processed by the intermediate amplifier and the square law detector produces the output propotional to the square of the input envelope and finally the strength is displayed.

In microwave radiometry the limited resolution as well as difficulties in image reconstruction and interpretation of the results is a disadvantage. The advantage of active microwave imaging arise from the image contrast of electrical properties between normal and malignant man tissues.

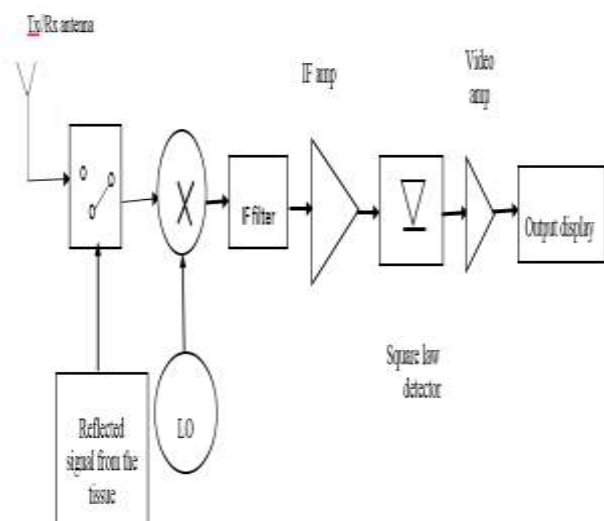


Fig.1.Block Diagram

4. CONCLUSION

The various works on microwave radiometry is discussed and a new method on diabetic foot ulcer, a design of a flexible antenna array and leg phantom with and without wound is designed using the HFSS and using the parameters E-Field and H-field, current density and SAR the result is produced. This study proves that antenna guarantees a decrease in the results of the electric fields, magnetic fields and current density inside healthy tissue with the existence of wound in the leg compared with a leg without wound.

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