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Field Contour Estimation for Primitive Detection of Cancer

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Abstract

This paper presents a concept for the primitive detection of cancer using field contour estimation. The dielectric characteristics of the sample are used to analyze the radiation characteristics emitted from the test antenna. The radiation pattern analysis is done for various foreign bodies on the dielectric material to estimate the field distribution. The field variation caused on the normal sample is used as reference to detect variation in the field distribution for identifying cancer cells in the primitive stage. The experimental setup has been done and analyzed using horn antenna with resonant frequency as 10GHz.

Keywords: Cancer Cell, Dielectric, Radiation, Field Distribution, Horn Antenna.

I. Introduction

The body is made up of trillions of living cells. Normal body cells grow, divide into new cells, and die in an orderly way. During the early years of a person's life, normal cells divide faster to allow the person to grow. After the person becomes an adult, most cells divide only to replace worn-out, damaged, or dying cells. Cancer begins when cells in a part of the body start to grow out of control. Cancer cell growth is different from normal cell growth. Instead of dying, cancer cells keep on growing and form new cancer cells. When cancer cells get into the blood stream or lymph vessels, they can travel to other parts of the body. There they begin to grow and form new tumours that replace normal tissue. This process is called *metastasis*. For instance, breast cancer that has spread to the liver is still breast cancer, not liver cancer. Not all tumours are cancerous. Tumours that aren't cancer are called *benign* [1]. Benign tumours can cause problems; they can grow very large and press on healthy organs and tissues. But they cannot grow into other tissues. Because of this, they also can't spread to other parts of the body (metastasize). These tumours are almost never life threatening. The current clinical imaging diagnosis tools for stroke detection include Computed Tomography (CT), Magnetic resonant Imaging scanning (MRI), Positron Emission Tomography (PET) and ultrasound. Unfortunately these tools are not suitable for continuous monitoring due to cost, time consuming imaging operations and the imaging equipment is not portable [2]. Moreover, CT imaging uses ionizing radiation that is harmful to the patient. These circumstances motivate the interest for new technologies that can integrate with currently available imagining technologies to improve the overall effectiveness of the diagnosis [3].

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II. Field Contour Detection

The radiation of electromagnetic waves contains both the electric and magnetic field. The electromagnetic fields when allowed to get exposed on the dielectric material (tissue/cell) sample, it energizes the molecules and ions of the particles [4]. This indirectly activates the cells under exposure. These electromagnetic signals will have the boundary formed on the cell structure and create a specific E-Field and H-Field distribution [5]. This field boundary is analysed for the samples with normal cell structure and abnormal disoriented structures. The field distribution and boundary evaluation of field structure on the cell areas can be detected based on absorbing nature with a proper receiver antenna unit connected to a detector and signal processing unit [6]. When the same procedure is adopted on the affected sample, the field pattern gets disturbed on the affected area due to the formation of cell clusters. The difference of cell alignment in the area under test will create a field contour region with field concentration bounded within that area with abnormality. This field concentrated area helps to create a hot spot. This helps to identify the cell structure disturbed area to predict the cancer formation so early to save and enhance the life of individual.

III. Methodology

The block diagram of the system is Fig. 1. Whenever a sample under test is exposed to radiation without any concentration of cell structure it exhibits a uniform normal field distribution with absorbing nature. This provides a suitable amount of attenuation loss on the receiving antenna signal processing unit. When artificially a cell concentration is created in the uniform cell sample under consideration, the amount of signal reflection from the cell concentration area gets changed. Also the amount of signal received at the receiving signal detector unit connected unit will exhibit a different amount of attenuated signal. Thus the field analysis can be proved experimentally using the field contour method to achieve primitive detection and needful prevention from further spreading with a result of cure to the affected person.

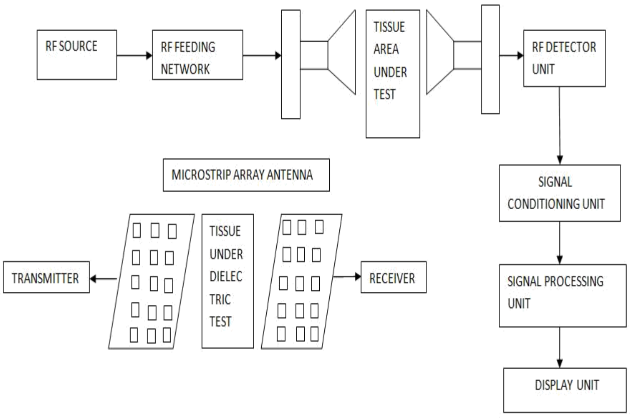

Figure 1. Radiation Test Environment

In cancer primitive detection system a broad beam is being transmitted from the pyramidal horn antenna to penetrate the tissue of the affected area. The radiated signal is continuously exposed on the sample for analysing the scattered signal from different layers of the tissue. This is observed using another antenna that act as the receiver of signal after transmission. The nature of the radiation pattern generated after passing the sample is observed and recorded to find the abnormalities present surrounding the area of test tissue. The process is being repeated until the antennas have been used simultaneously as transmitter and scattered fields are recorded. The second step involves the reconstruction of dielectric properties and profiles of the object under test with the use of measured field data. Thus the system will be most efficient to the present world population to have early detection from cancer.

Figure 2. Experimental Setup without Sample

a. Experimental setup without sample

From the Fig. 2, the experimental set up transmitted signal power is measured and the radiation pattern of the antenna is obtained. From the measured value, we can find out whether the radiation pattern get reflected, refracted or scattered. From the measured readings the antenna pattern has been observed.

b. Experimental setup with sample

In this experimental setup, the transmitted power is exposed on the sample and the radiation pattern of the sample is obtained. From the radiation pattern it is revealed that how the E and H field get distributed. If any cluster of cell is presented the field get disturbed which means field scattered or dispersed, reflect, refract. Then measured field value of air and measured field of sample gets differs this shows that how the field get concentrated over the cancer formed area. The experiment shown in Fig. 3, has been tested using the two different dielectric materials as air (Normal Tissue) and foam (affected Tissue) and various readings has been tabulated. The reading shows difference of power while using the dielectric medium and its polar plots has been plotted.

Figure 3. Experimental Setup with Sample

IV. Results and Discussion

From the Fig. 4, the radiation undergoes the properties of EM waves such as radiation, reflection and diffraction. The radiation pattern using Normal Tissue has no side lobe. The EM waves which passes through the affected Tissue has different radiation pattern which result with more side lobes and is shown in Fig. 5. From this radiation Pattern the affected cells will be identified.

Table 1. Analysis of Measured Field with and without sample

MEASURED FIELD			
AIR MEDIUM		WITH THE SAMPLE	
ANGLE (Degree)	POWER (dBm)	ANGLE (Degree)	POWER (dBm)
0	6.42	0	2.92
10	4.73	10	2.90
20	-3.25	20	-1.71
30	-15.89	30	-11.88
40	-22.86	40	-22.58
50	-35.70	50	-33.21
60	-35.90	60	-35.80
70	-36	70	-34.70
80	-35.29	80	-31.10
90	-35.95	90	-31.86
100	-38.45	100	-31.16
110	-38.24	110	-32.64
120	-37.45	120	-30.70
130	-36.65	130	-30.76
140	-35.95	140	-32.88
150	-38.60	150	-32.57
160	-39.99	160	-32.46
170	-30.05	170	-39.99
180	-28.30	180	-34.51
190	-26.78	190	-33.65
200	-27.57	200	-39.99
210	-30.94	210	-32.42
220	-39.99	220	-30.68
230	-39.99	230	-31.67
240	-37.28	240	-30.60
250	-34.42	250	-30.66
260	-35.02	260	-31.19
270	-35.44	270	-31.21
280	-35.87	280	-31.38
290	-37.75	290	-30.73
300	-38.10	300	-30.20
310	-39.99	310	-33.04
320	-28.15	320	-34.04
330	-16.36	330	-22.98
340	-5.16	340	-10.89
350	-1.11	350	-0.50
360	5.97	360	2.38

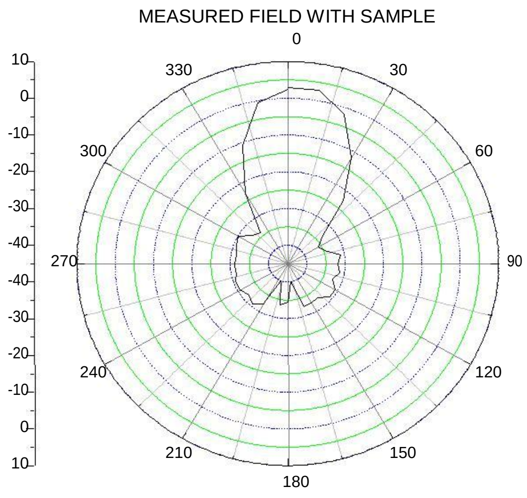

Figure 4. Radiation pattern with sample

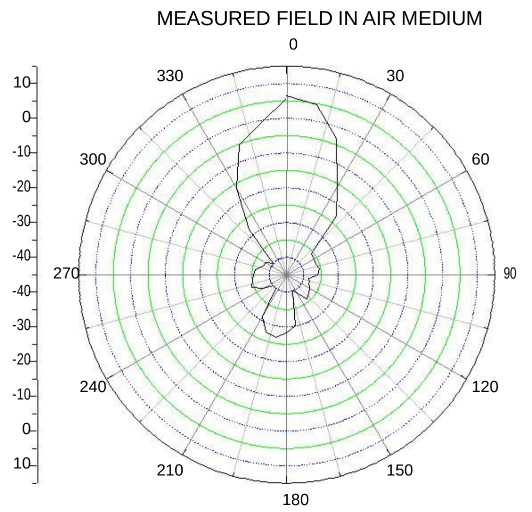

Figure 5. Radiation pattern without sample

V. Conclusion

This paper presents a concept for the primitive detection of cancer using field contour estimation. The dielectric has been used to analyze the radiation characteristics emitted from the test antenna. The radiation pattern for different dielectric material has been analyzed. The field variation caused on the normal sample is used as reference to detect variation in the field distribution for identifying cancer cells in the primitive stage. The experimental setup has been done and analyzed using horn antenna with resonant frequency as 10GHz.

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