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A Novel Method for Detection of Breast Cancer or Tumor

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Abstract
Microwave system for breast cancer detection is a promising method, based on the large contrast of electric parameters between the malignant tumor and its surrounded normal breast organisms. The comparison of the transmission characteristics of the plane wave through the normal breast media and defected breast media are taken into account to differentiate between them. The dielectric constants of defected cells are much higher than the normal breast cells. The specific absorption ratio (SAR) of the normal and defected medium is also different which is studied in this article.

Keywords
Normal Tissue; Defected Tissue; Specific Absorption Ratio; Transmitted Field Through Breast Medium.

I. Introduction

The probability of occurrence of breast cancer among women is highest compared to other form of cancer. Treatment of cancer presently available with medical science is effective only if treatment starts during initial phase of the cancer. Hence the emphasis is on detection of cancer in its initial phase. Modern medical diagnosis techniques are available for cancer detection such as ultrasound, X-ray mammography, magnetic resonance imaging (MRI), microwave imaging etc [1]. But there are many limitations of these techniques such as the rate of missed detection is very high, the mammographic technique i.e ionizing radiation is very expensive and so on. Compared with other technique, microwave imaging system for the detection of breast tumor is a comfortable, potentially low cost, nonionizing and safe alternative [2]. The dielectric constant of the malignant or defected tissue is much higher than the normal breast tissue should manifest itself in terms of lower numbers of missed detections and false positives [3-4]. The microwave system for breast tumor detection has the potential to be both sensitive and specific to detect small tumors. Microwaves are electromagnetic waves. The contrast of dielectric properties of normal and defected tissue arises at microwave frequencies due to their water content. The dielectric constant of malignant tissue is higher i.e. five times than normal tissue due to the water containing capacity of malignant tissue is much higher than normal tissue which makes significant scattering when the electromagnetic waves are transmitted over the tissue [5]. For breast cancer detection the basic idea of using microwave imaging system is the transmitting antenna transmit electromagnetic waves through the breast and a receiving antenna receives the scattered waves [6-7]. The vital information regarding the tumor size, shape, location and electrical properties are contained in these received waves. In this study a plane electromagnetic waves are inserted on a breast model and transmitted over the tissue. Then the scattered waves are received by the near field.

II. Design of the Model

A CAD Breast Model has been prepared using FEKO software shown in fig. 1. The CAD model is approximate replica of human breast. The model was designed with a skin layer of thickness 3mm and outer radius of 25 mm. A fibro glandular breast fatty tissue layer of radius 22mm is situated inside the skin layer .Plane wave is made incident through the Z axis towards the CAD model and field is situated at 4mm. The breast model is excited by plane wave excitation. The plane wave is passed through the model and then received by the field. Different characterization of the model is shown. A defected cell is situated inside the fibro glandular breast fatty tissue layer. Characteristic curve is plotted for different sizes of defected cells. It is shown that characteristics are changed with respect to the changing dimensions of the defected cell. The dielectric constants of different layers of the breast model are shown in Table 1.

Table 1: Debye Model Parameters for the Normal Breast Tissue, the Defected and the Skin

Dielectric medium	Dielectric constant	Conductivity
Skin	46.7	1.1
Normal tissue	9	0.15
Defected tissue	50	0.7

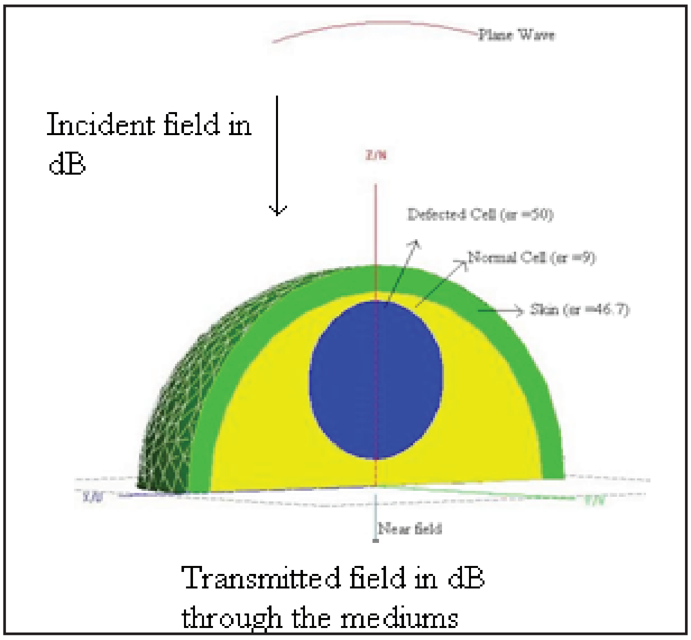

Fig. 1: Layout of the Design

III. Results and Discussions

The transmission property through breast medium is different for normal and defected tissue. It is also changed with respect to the dimension of the defected tissue. Here the radius of the defected tissue is varied from 1mm to 10mm. The transmission characteristics of normal tissue and tumor of radius 5mm, 8mm & 10mm are plotted in fig. 2. So the transmission characteristic of the normal tissue and defected tissue of radius 8mm is plotted in Fig.3.From the Fig.3 it is easily differentiated between the normal tissue and the defected tissue. Specific Absorption Ratio (SAR) of the normal breast tissue and the tumor of radius 5mm, 8mm & 10mm are also plotted in fig. 4. From these two comparative graphs it is conclude that the transmitted power is minimum and

SAR is maximum for the defected tissue with 8mm radius. SAR Vs Frequency value of the normal and defected tissue of radius 8mm is plotted in Fig 5 and Fig. 6 respectively. The maximum SAR value of the normal tissue is 0.00001 at 8GHz frequency and 0.0035 at 4GHz frequency for the defected tissue.

Note:- If the figures have been shown in double column format, then the figures would be illegible, so the figures are given in single column format.

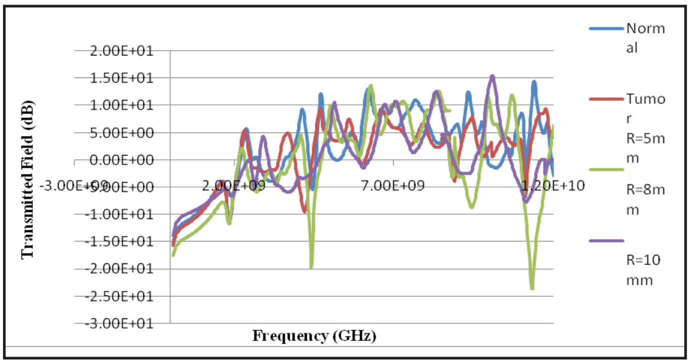

Fig. 2: Transmitted Field Vs Frequency Plot with normal cell, 5mm Tumor, 8mm Tumor and 10mm Tumor

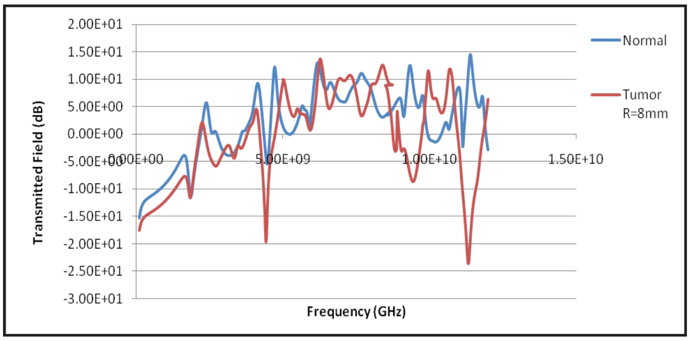

Fig. 3: Transmitted Field Vs Frequency Plot of the Normal Cell and Tumor of radius 8mm

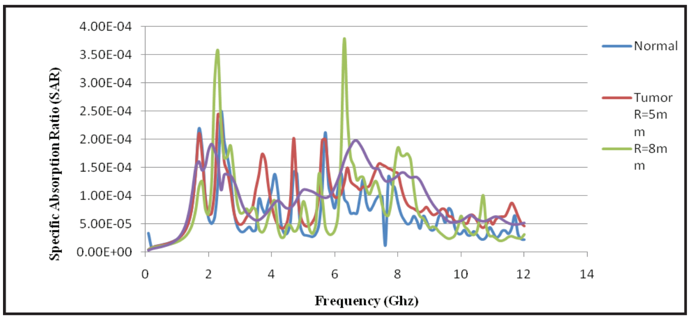

Fig. 4: Averaged SAR value for compressed breast model with normal cell, 5mm Tumor, 8mm Tumor and 10mm Tumor

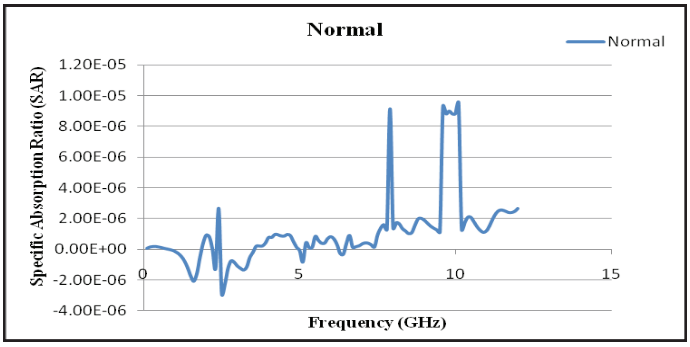

Fig. 5: Averaged SAR Value for Compressed Breast Model with Normal Cell

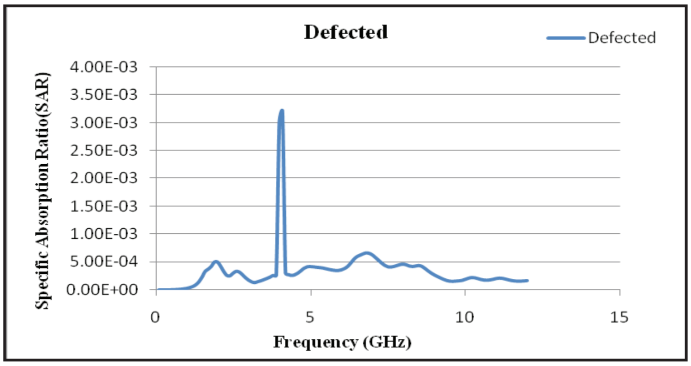

Fig. 6: Averaged SAR Value for Compressed Breast Model With Normal Cell

IV. Conclusion

Breast tumor or cancer detection is studied through simulation using FEKO software. Simulated results show that it is feasible to detect a small sized circular tumor. From the figures, it is shown that the normal and defected cells are easily differentiated. The Specific Absorption Ratio (SAR) values of the normal and defected cells are also different for a particular given range of frequencies. Transmitted field and Specific Absorption Ratio are also studied for different sizes of the tumor. There are many techniques are currently used to detect breast cancer but detection by this method is commercially very cheap and simple.

V. Acknowledgement

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