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## Breast cancer detection using microstrip patch antenna

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### ABSTRACT

*Breast cancer is an invasive disease in women which needs early detection. Different approaches have been done to detect cancer using different types of antenna-like circular patch antenna, microstrip antenna, t-shaped slotted antenna and slotted rectangular antenna. There are even many techniques for the detection of breast cancer like mammography, microwave imaging which have limitations. The microwave imaging is safer method when compared to X-Ray. In this review paper, a circular microstrip patch antenna using FR-4 substrate, microstrip slot antenna, rectangular microstrip patch antenna, hemispherical antenna array, Pentagonal patch antenna array which resonates at different frequencies are used to detect the breast cancer.*

**Keywords:** Breast cancer, Detection, Patch antenna.

### 1. INTRODUCTION

Cancer is a disease in which abnormal cells divide uncontrollably and destroy body tissues. Among different types of cancers, breast cancers are one of the harmful diseases that kill thousands of people every year. Approximately 40,610 women and 460 men are expected to die from breast cancer in 2017 [1]. Breast cancer has ranked number one cancer, among Indian females with age-adjusted rate as high as 25.8 per 100,000 women and mortality 12.7 per 100,000 of women in 2017 [2]. The performance and advantage of microstrip called namely low cost, low weight, compact design, good Gain, low profile makes them perfect for communication engineers. These patches are capable to integrate with microwave. Circuits and therefore very breast well suited for many applications such as cell devices, bio-medical, WLAN applications, navigation system and many others.

Imaging techniques and Ultra-Wide Band detection are being studied and used for medical applications such as microwave

imaging. UWB techniques for cancer detection have several advantages in the frequency band corresponding to these ultra-short radar pulses, a significant contrast appears between the relative dielectric permittivity and conductivity of healthy tissues and those of malignant tissues. These impulses provide a sufficient and their characteristics strongly impact the performance of the overall system. Antennas are capable of detecting the tumor.

Different types of antennas are used for the detection of breast cancer have been studied and discussed in this review paper. Antennas like circular microstrip patch antenna, UW microstrip slot, rectangular microstrip patch antenna, hemispherical antenna array and pentagonal patch antenna array are studied considering different parameters of each.

**2. METHODOLOGY**

**2.1 Circular Microstrip Patch Antenna**

A circular microstrip patch which resonates at 2.45GHz, using 37.26x28.82mm dimensions, on an FR-4 substrate with relative permittivity  $\epsilon_r=4.4$ , using a dimension of 65.4mm width and 88.99mm of length with 1.588mm of thickness is designed using a software called HFSS. To study about the electric fields, magnetic fields, current densities of the normal breast tissues and tumour affected breast tissues; five different antennas are studded and are placed on the skin of the breast shape. Thus, antenna is modelled, simulated and optimized in HFSS and better results are found out [3].

**2.2 Microstrip Slot Antenna**

A microstrip slot antenna that resonates with a frequency of 6.3GHz, dielectric of 4.2 and height is of 1.6mm and results with a gain of 4.0087Db with VSWR of within 2. It also resonates within an ultra-wide band of 3GHz is designed. In this paper, the proposed antenna has wide rectangular slot on one substrate side and on other side substrate forked microstrip feed which increases the bandwidth. This approach is a radar-based microwave imaging system that is used to detect the breast cancer in early stages which is of low cost, non-radiative, easy use, high image resoluteive [4].

**2.3 Rectangular Microstrip Patch Antenna**

A rectangular microstrip patch antenna (RMPA) resonates at 2.45GHZ which is designed for ISM band application. In this paper the substrate height is 1.6mm, Dielectric Constant is 4.3 and loss tangent is 0.002. The parameters are displayed using the figures. Physical sizes are important in the designing process. The antenna is designed for the ISM band and the Breast phantom model is designed with tumour. The models are simulated and designed on CST-2104[5].

**2.4 Radar-Based Breast Cancer Detection using Hemispherical Antenna Array**

In this paper the breast cancer is detected using radar-based breast phantom model with the electrical properties like the of hemisphere. The aperture antenna is the modified version of planar antenna used in the breast cancer detection. The cavity is added to the antenna to avoid the loss of back radiations and the front face of the antenna to avoid the coupling, a metallic screen of 5mm is included. During the design process the FDTD numerical solver is included. During measurements the antenna is connected to the electromechanical switches, the group of these switches connects them to a vector network analyser (VNA) which perform the radar measurement in the frequency domain. The sixteen antenna elements in the array, records some one hundred and twenty measurements. This technique is successfully detected the spherical tumours of diameter 4 and 6mm in the curved breast phantom [6].

**2.5 4\*4 Pentagonal Patch Antenna Array**

A wideband and planar pentagonal patch antenna uses FR-4 substrate with the thickness of 1.6m and 4\*4 arrays. The amplitude of reflection coefficient is less than 2.2 GHz. HFSS software is used for the simulation. While -5db for the frequency greater simulation the breast was modelled by 2mm thickness. The frequency characteristic of s-parameters has been calculated and measured [7].

**3. REVIEW TABLE**

Antenna Type	Circular Patch	Microstrip Patch	Rectangular patch	Pentagon Patch
Frequency	2.45Ghz	6.3Ghz	2.45GHZ	>2.2Ghz
Gain	3.28db	4db	4.007db	-
VSWR	>2	<2	<=2	-
Software	HFSS	ADS	CST	HFSS
Substrate	FR-4	FR-4	FR-4	FR-4
Dielectric constant	4.4	4.6	4.3	4.2
Substrate thickness	1.6mm	1.6mm	1.6mm	1.6mm
Return loss	-21.8db	-16.4db	-12db	-

**4. CONCLUSION**

In this paper, we discussed different antennas for the detection of breast cancer. Here we concluded that antennas are capable of detecting the tumor. They are first simulated in different frequencies for different antennas. The results are checked based on the parameters like Gain, VSWR, and dielectric constant and return loss. The simulation also indicates good impedance matching. In our proposed system, microstrip patch antenna is used for the detection of the resonant frequency of 2.45 GHz using CST software. The simulation results show all the above parameters by single microstrip antenna. And the antenna design is fabricated and tested using Network Analyzer [8].

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