International Journal of Scientific Research Engineering & Technology (IJSRET)
Volume 1 Issue5 pp 234-237 August 2012 www.ijsret.org ISSN 2278 – 0882

Breast Cancer Detection Using Ultra wideband

[1]Nalini Tyagi, [2]Rahul Gupta, [3]Ruchi Singh
[1] M. Tech Student, Department of ECE, Sunderdeep Engineering College Ghaziabad
[2, 3] M. Tech Student, Department of ECE, IIMT Meerut
[1] nalinityagi2010@gmail.com, [2] rahul03gupta@yahoo.com, [3] ruchi15singh@gmail.com

ABSTRACT

Breast cancer is a second leading cause of cancer in women today after lung cancer and is the most common cancer among women according to WHO. At present X-ray Mammography is approved technique for early breast cancer detection. But this technique have up to 20% false detection rate. There will be approximately 250,000 new cases of breast cancer in India by 2015. At present, India reports around 100,000 new incidence of breast cancer. We can eliminate this false detection using Microwave imaging. Microwave imaging is defined as \seeing" the internal structure of an object by means of electromagnetic fields at microwave frequencies {300 MHz- 10 GHz}.

Antenna is a key component in microwave imaging system. Micro strip antenna can become right candidate for Microwave imaging system. Because it is compact and planar but major drawback is its narrow bandwidth. But using deferent technique we can increase bandwidth up to 70% Microwave imaging has been suggested as a promising modality for early-stage breast cancer detection. In this paper, we propose a statistical microwave imaging technique wherein a set of generalized likelihood ratio tests (GLRT) is applied to microwave backscatter data to determine the presence and location of strong scatterers such as malignant tumors in the breast. The GLRT is formulated assuming that the backscatter data is Gaussian distributed with known covariance matrix. We describe the method for estimating this covariance matrix offline and formulating a GLRT for several heterogeneous two-dimensional (2-D) numerical breast phantoms, several three-dimensional (3-D) experimental breast phantoms, and a 3-D numerical breast phantom with a realistic half-ellipsoid shape. Using the GLRT with the estimated covariance matrix and a threshold chosen to constrain the false discovery rate (FDR) of the image, we show the capability to detect and localize small (<0.6 cm) tumors in our numerical and experimental breast phantoms even when the dielectric contrast of the malignant-to-normal tissue is below 2:1.Single Layer Rectangular Micro strip Antennas with simple capacitive feed, offering an impedance bandwidth up to 50% is designed in IISc., Bangalore, India 2007 [1]. The proposed antenna is modification of above antenna. In this antenna, we replace rectangular patch with rectangular ring patch which increases impedance bandwidth more than 66.44% having resonance frequency 6.05 GHz.

I. INTRODUCTION

Detecting breast cancer in its earliest stages is looked upon as the best hope for successful treatment of the disease the limitations of conventional X-ray mammograms are well-recognized and in response to these limitations several complementary modalities for breast cancer are under investigation. Active microwave imaging is one promising alternative screening technology that is nonionizing, noninvasive, and does not require breast compression. For this modality, low-power electromagnetic waves that are transmitted into the breast undergo scattering or selective heating/absorption due to the dielectric contrast between malignant tumors and normal breast tissue at microwave frequencies. The received signals are processed to extract information about the tissue dielectric-properties distribution or other tissue characteristics of the breast. Microwave breast imaging can be divided into three categories: hybrid microwave-induced acoustic imaging, microwave tomography , and ultra wideband (UWB) radar techniques. In the hybrid approach microwave signals are transmitted into the breast to heat tumors and ultrasound transducers detect the pressure waves generated by tumor expansion. In tomographic image reconstruction, a nonlinear inverse scattering problem is solved to recover an image of the dielectric properties in the breast. In contrast to the image recovery goal of tomography, the proposed UWB radar approach solves a simpler computational problem by seeking only to identify the presence and location of significant scatterers such as malignant breast tumors. In the UWB radar approach, high bandwidths and large antenna apertures are used to improve spatial resolution at microwave frequencies Previously UWB radar investigations have used beam-forming techniques of varying complexity to synthetically focus scattered signals toward a point in the breast and calculate the corresponding scattered energy. Images obtained by beam forming are maps of the focused backscatter energy as a function of position where strong scatterers such as malignant tumors are identified as high-energy regions in the image. One method for creating a synthetic focal point is confocal imaging which employs simple delay-and-sum beam forming. While confocal processing is computationally inexpensive, it does not account for dispersive propagation effects in breast tissue or fractional time delays and the simple filter design has limited ability to discriminate against artifacts and noise. An alternative focal technique, microwave imaging via space-time (MIST) beam forming , uses filters that compensate for dispersion and fractional time delays. The filters solve a penalized least-squares problem such that signals originating from a candidate tumor location are passed with approximately unit amplitude and linear phase while the white noise gain is constrained. This filter design dramatically improves clutter suppression and spatial discrimination compared to the earlier delay-and-sum beam formers X-Ray mammography is only detection method which is approved by U.S. Food and Drug Administration (FDA). In X-Ray Mammography, low dose X-ray are scattered on breast surface. But by this technique, we can not get 100% result, and 100% result is desirable in early stage breast cancer detection so that we can cure cancer at primary stage. X-Ray mammography is not recommended for young girl by FDA also. But we can eliminate above limitation if we use Microwave Imaging technique. At microwave frequency, there is significant deference of dielectric constant between normal and malignant breast tissue so that we can get clearer picture of malignant tissue.

There are many UWB antenna are available for wireless application such as Vivaldi antenna, Horn antenna, Unipolar antenna, Bowtie antenna. But they have some merit and some demerit such as bulky, non planar, costly and bidirectional radiation pattern. Antenna array becomes complex and non planar surface if antenna is bulky and non planar. Bidirectional radiation pattern also reduces antenna gain which is not desirable [6{15]. Micro strip antenna can become right candidate for Microwave imaging system because it is in small size, light weight, low cast and also planar [16]. Major drawback of microstrip antenna is narrow bandwidth, typically 1{5% impedance bandwidth [16]. But using different techniques, we can get larger impedance bandwidth. One of such technique is aperture couple feeding method in stack configuration. Using this technique, first time in 2007 Aperture Coupled Stacked Patch Micro strip Antenna is designed with 77% impedance bandwidth at University of Bristol, U.K. for breast cancer detection [17]. But these configuration cause alignment issues while assembling and hence may increase the production cast. And Primary advantage of MSA lies in there eases of fabrication by standard lithographic techniques.

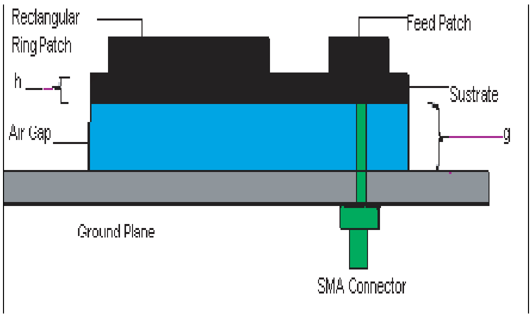
Single Layer Rectangular Micro strip Antennas with simple capacitive feed, offering an impedance bandwidth up to 50% is designed in IISc., Bangalore, India 2007 [1]. The proposed antenna is modification of above antenna. In this antenna, we replace rectangular patch with rectangular ring patch which increases impedance bandwidth more than 66.4% having resonance frequency 6.05 GHz due to inductive impedance match with some approximation and also it has no misalignment problem, so antenna will be cheaper.

II. ANTENNA DESIGN AND DISCUSSION

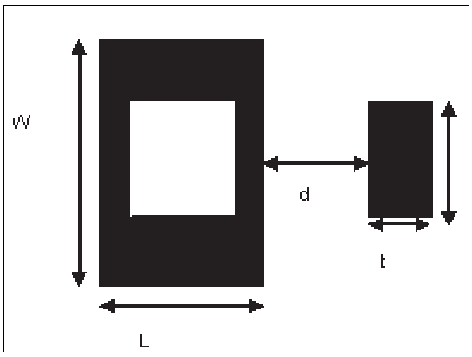
We have design antenna using IE3D v.12 antenna simulator. Following are the antenna parameters.
Width of the radiator patch (W) = 25:5 mm.
Length of the radiator patch (L) = 15:5 mm
Length of the feed strip (s) = 3:7 mm.
Width of the feed strip (l) = 1:2 mm.
Separation of the feed strip from the patch (d) = 0:5 mm
Air gap between substrates (g) = 6:0 mm.
Relative dielectric constant ("r) = 3:0.
Thickness of substrate (h) = 1:56 mm
Blank inner square area = 5 £ 5mm2.
Here, two type of rectangular patches are used, one patch are rectangular ring and other are small rectangular patch. Rectangular ring patch is used for radiation and small rectangular patch is used for coaxial probe feed. Hole on radiating patch will increase the bandwidth of antenna [16 18 19]. But it doesn't mean that increasing more and more area of hole, increase bandwidth of antenna. Because of certain limiting area of whole, antenna will go higher mode of propagation [19].

Length (L) and width (W) of rectangular ring patch is 15.5 mm and 25.5 mm. Length and width the feed strip is 3.7 mm and 1.2 mm. Above infinite ground plane, there is air gap of thickness 6.0 mm which have dielectric constant 1.07 and loss tangent 0.0009. A substrate having dielectric constant 3.0 cover air gap and thickness and loss tangent of substrate is 1.56 mm and 0.0013. Over substrate rectangular ring patch and feed stip patch are sited. Coaxial probe feed is used for excitation of antenna. Separation of rectangular ring from feed is 0.5 mm.

Figure 2 shows return loss of the proposed antenna. Proposed antenna have return loss less than ¡9:5 dB loss from frequency range 4.4 GHz to 8.42 GHz and bandwidth of antenna is 4.02 GHz. This wide bandwidth is useful for taking image with high resolution and it also help in fast signal processing. This antenna has 66.44% impedance bandwidth so it is UWB antenna because we all know that UWB devices have at least 20% impedance bandwidth.



(a) Cross-sectional View



(b) Top View

Figure 1: Geometry of rectangular ring micro strip antenna with small capacitive feed.

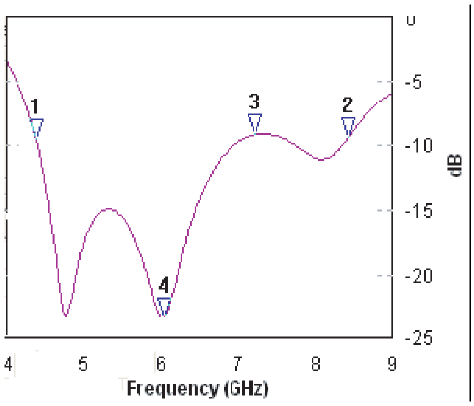


Figure 2: Return loss with frequency

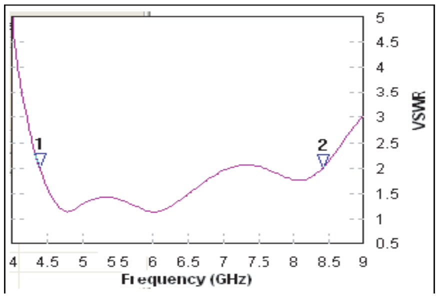


Figure 3: VSWR with frequency

Figure 3 shows variation of VSWR with frequency which also show satisfactory result i.e., at all frequency VSWR within value 2.0 except 7.22 GHz where VSWR value is 2.06. Figure 4 shows two dimensional radiation pattern of antenna and HPBW is 163.64 degree. This large HPBW is desirable in breast cancer detection because larger HPBW cover larger surface of breast. Figure 5 shows variation of antenna efficiency with frequency. Here maximum antenna efficiency is 87% and minimum antenna efficiency is 77.17% which are quite enough for image processing application.

Antenna gain is shown in Figure 6. All antenna gain is up to 6.88 dBi. And Figure 7 shows three dimensional view of radiation pattern.

All above results such as 66.44% impedance bandwidth, 163.64 degree HPBW, antenna efficiency more than 77.17%, antenna gain up to 6.88 dBi are very satisfactory results for micro strip antenna in microwave imaging system for early breast cancer detection. But radiation pattern are not °at in whole bandwidth and retune loss of antenna have one peaks between frequency ranges 4.4 to 8.42 GHz. Such things are undesirable but it will not create any significant error in image processing

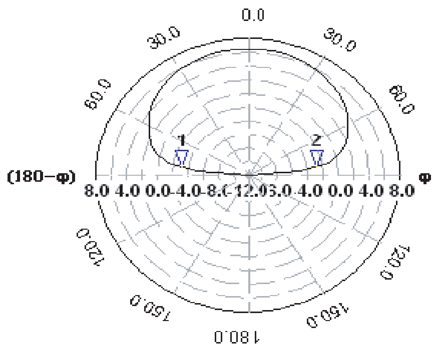


Figure 4: 2D radiation pattern of antenna.

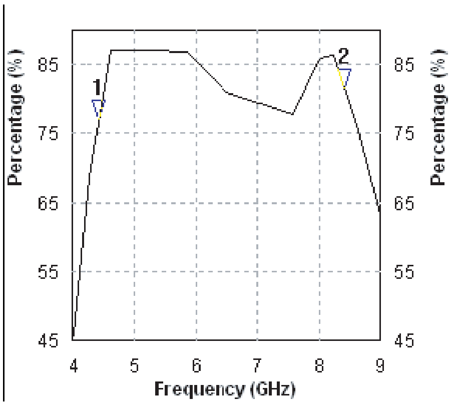


Figure 5: Efficiency of antenna

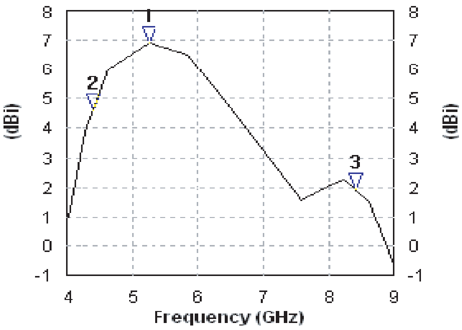


Figure 6: Gain with frequency for antenna.

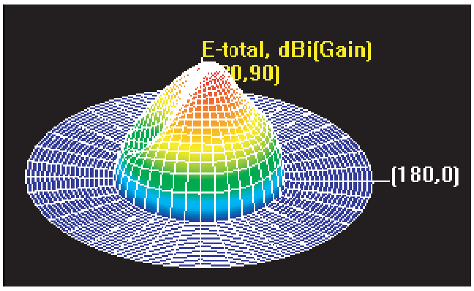


Figure 7: 3D radiation pattern of antenna

REFERENCES

[1] Kasabegoudar, V. G., D. S. Upadhyay, and K. J. Vinoy, \Design studies of ultra-wideband microstrip antenna with a small capacitive feed," International Journal of Antenna and Prop-agation, Vol. 2007, Article ID 67503, 8, 2007, doi:1155/2007/67503.
[2] Mayhew-Ridger, G., J. W. Odendaal, and J. Joubert, \Single layer capacitive feed for wideband probe-feed microstrip antenna elements," IEEE Transactions on Antennas and Propagation, Vol. 51, No. 6, June 2003.
[3] Vandenbosch, G. A. E. and A. R. Van de Capelle, \Study of the capacitive feed microstrip antenna elements," IEEE Transactions on Antennas and Propagation, 1994
[4] Fear, E. C., et al., “Confocal microwave imaging for breast cancer detection: Localization of tumors in three dimension," IEEE Transaction on Biomedical Engineering, Vol. 49, No. 8, August 2002