Ultra-Wideband Antennas for Breast Cancer Detection

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Novel ultra-wideband antenna sensor have been proposed for breast cancer detection. Further, three types of breast phantoms (without tumor, a signal tumor, and two tumors) are fabricated using organic material. Also, reflection coefficient response has been recorded by putting the antenna on the top of those breast phantom. After that reflection coefficients have been converted into the principal component analysis (PCA) with the help of machine learning. Further, the tumour's locations in the breast phantom are find out by using the specific absorption rate (SAR) values.

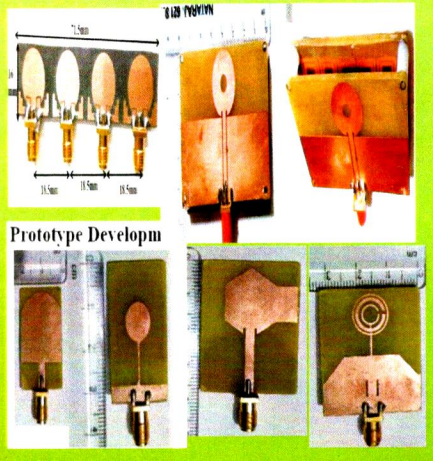
INTRODUCTION

Society (ACS) report in 2021, 281550 and 2650 new cases of invasive breast cancer (malignant cells) have been estimated among women, and man respectively in the United States of America. It is estimated that more than 43,600 women died of breast cancer. It has been clearly observed that the rate of being live of the patient is increased by 80-90% if cancer is detected at the early stage (first five years).

➢The various techniques for the detection of breast cancer are ultrasound scanning, X-ray mammography, computed tomography(CT) scan and magnetic resonance imaging (MRI), etc.. Those methods have various challenges and limitations such as reliability, cost, accuracy of performance, comfort for patients, the health risk due to ionizer radiation for computer tomography and x-rays.

❖ Microwave sensing (MS) has a lot of advantages over standard breast screening techniques. The sensing techniques for the detection of breast cancer are non-invasive, low-cost, comfortable, and very useful in malignant tumor detection.

UWB ANTENNAS



SENSING MECHANISM

In this sensing mechanism, the process of malignant tumor detection is based on fact that virtually all human breasts (right and left) are symmetrical in shape, content, and electrical properties. Two identical sensors are used for simultaneous monitoring of the right and left breasts in this detection technique. The sensing process is shown in fig.1, which describe the processes of breast cancer detection technique.

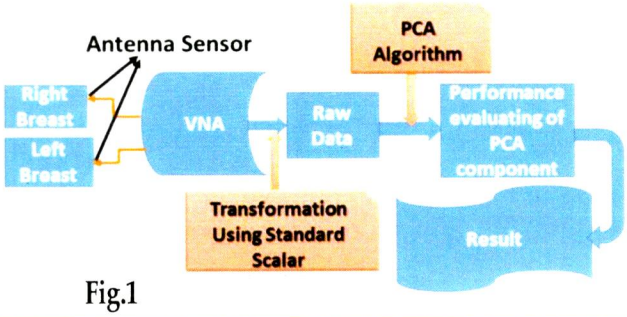


Fig.1

Experimental Process

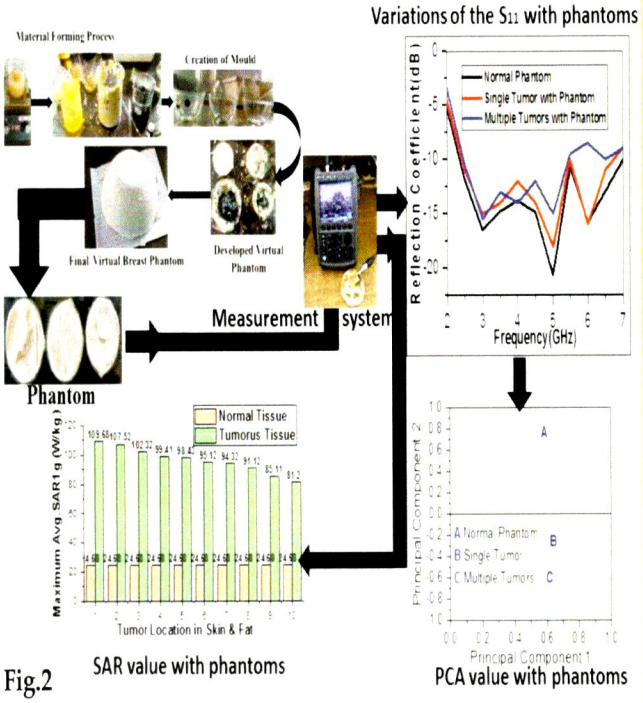


Fig.2 SAR value with phantoms PCA value with phantoms

SUMMARY OF THE INVENTION

The detection of breast cancer by electromagnetic radiation depends on a few parameters like its dielectric properties, conductivity, and permittivity. In case of normal tissues, these parameters are 10 to 15 times lower than those of cancerous tissue. Breast phantom models are developed with and without tumours using organic material having similar electrical properties to human tissues. Further different type of antenna sensor has been also simulated and fabricated for tumour detection. Then with the help of experimental setup, tumours are detected.

There are two methods that have been applied here in this project.

1. Principal Component Analysis (PCA)
2. Specific Absorption Rate (SAR) Analysis.

The PCA method implemented here uses antenna sensor for monitoring of reflection coefficient responses from breast phantoms. These responses are analysed using principal component analysis (PCA). The PC1 and PC2 values for the phantom with a multiple (two) tumours, with single tumour and normal phantom, are different, which clearly differentiate the normal and cancerous breast. SAR analysis depends on material conductivity. Tumorous tissue conductivity higher than normal tissue conductivity and thus it gives higher SAR compare to normal tissue.

➢ Advantages of proposed methods

safe, low cost, comfortable, easy to use, non- ionizing and non-invasive.

➢ Application

Breast cancer detection and other medical application

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