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Design of Compact UWB antenna for the Detection of Breast Cancer Tumor

Dhamodharan Srinivasan[1], Mohanbabu Gopalakrishnan[2]

Assistant Professor[1], Associate Professor[2], Department of ECE, SSM Institute of Engineering and Technology, Dindigul
dhamu20@gmail.com, shamyubabu@gmail.com

Abstract

A coplanar waveguide (CPW) feed metamaterial inspired rectangular antenna is proposed for breast tumor detection here. The antenna is designed on a Roger RT5880 substrate with the size of 26 mm x 31 mm x 0.127 mm. The proposed antenna has a dual band characteristic operating from 2.86 GHz to 9.53 GHz and 14.0 GHz to 14.89 GHz. The proposed antenna has an Ultra-wideband characteristic with the band width of 6.72 GHz in the frequency range 2.86 GHz to 9.53 GHz. The simulated result of the proposed antenna shows a very good performance in terms of impedance matching, gain, radiation pattern. The proposed antenna is implemented with human breast model in order to detect the tumor. The size and location of the tumor varies and the SAR results are presented. The coordinates of the SAR maximum values are used to detect the location of the tumor inside the breast and the result clearly shows that the proposed antenna has very high precision in identifying the tumor inside the breast. The entire simulation is carried out using CST studio EM software.

Keywords: *Coplanar waveguide, Breast tumor, Ultra-wideband, SAR values, Radiation pattern.*

1. Introduction

The second largest cause of death among women's is breast cancer [1]. The available standard method to detect the breast cancers are MRI, Ultrasound and X ray. Out of which the most effective method to diagnose and detect is the X ray method. But the major disadvantage is that it cannot differentiate the benign tumor and malignant tumor and it also fails to detect the tumor at the initial stage [2]. In [3], 258 patients are studied out of which 177 having malignant and remaining having benign tumor. By combining the MRI and X ray techniques, the maximum sensitivity obtained in the result is 95% and accuracy is 77%. All these limitations lead to the development of new method which overcomes the disadvantage of all the previous methods. One such method is microwave imaging in ultrawide band frequency region. In recent days the MWI (microwave Imaging) becomes the most targeted technique by the researches because of its own advantage like low cost and complexity, high data rate and accuracy. The basic principle used in the MWI is based on the change in properties of the back-scatter signal which changes with respect to the change in the properties of the tissue. The antenna used in MWI is used at the transceiver to impinge signal on to the human tissue. The contrast in the dielectric properties of the normal and cancer tissue is the basic principle behind the microwave imaging [4, 11]. In the literature there are large number of UWB antennas reported but the size is larger [5,6]. Metamaterial are the artificial materials which has negative permittivity and permeability, whose properties are derived based on the structure rather than its constituents. They are included in the radiating element, ground or substrate in order to enhance the various parameter performance of the antenna.

Various types of metamaterial structures such as Split Ring Resonators (SRR), Complementary Split Ring Resonators (CSRR), Omega shaped and S shaped metamaterial are reported in the literature [7-10].In this paper, a novel metamaterial inspired UWB antenna is proposed for the breast tumor detection. A rectangular CPW antenna with hexagonal CSRR in the ground is introduced to convert the conventional UWB antenna into dual band antenna which is resonating at 7.8 GHz and 14.06GHz. The first band is the UWB band which normally used in the microwave imaging and the second band is the future extension of ISM band. The proposed structure is implemented with the breast model of three size of radius 50mm, 55mm and 60mm. A tumor of size 4 mm and 5 mm is introduced at different locations in the designed breast model. Then entire structure is analyzed for SAR with the help of CST studio. The SAR result of the proposed system is presented which clearly shows that the proposed metamaterial inspired CPW fed dual band antenna has very good detection competence. The antenna

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