

Hybrid graphene–copper UWB array sensor for brain tumor detection via scattering parameters in microwave detection system

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Abstract Hybrid graphene–copper ultra-wideband array sensor applied to microwave imaging technique is successfully used in detecting and visualizing tumor inside human brain. The sensor made of graphene coated film for the patch while copper for both the transmission line and parasitic element. The hybrid sensor performance is better than fully copper sensor. Hybrid sensor recorded wider bandwidth of 2.0–10.1 GHz compared with fully copper sensor operated from 2.5 to 10.1 GHz. Higher gain of 3.8–8.5 dB is presented by hybrid sensor, while fully copper sensor stated lower gain ranging from 2.6 to 6.7 dB. Both sensors recorded excellent total efficiency averaged at 97 and 94%, respectively. The sensor used for both transmits equivalent signal and receives backscattering signal from stratified human head model in detecting tumor. Difference in the data of the scattering parameters recorded from the head model with presence and absence of tumor is used as the main data to be further processed in confocal microwave imaging algorithm in generating image.

MATLAB software is utilized to analyze S-parameter signals obtained from measurement. Tumor presence is indicated by lower S-parameter values compared to higher values recorded by tumor absence.

1 Introduction

In 2030, around 13.2 million people worldwide will suffer and die because of cancer since cancer is one of the most complex diseases in the world [1]. Early cancer detection which allows early cancer treatment could increase the cure rates as the treatment is more efficient and effective compared with treatment done at the late stage of cancer. Conventional X-ray, magnetic resonance imaging (MRI), computed tomography (CT scan) and ultrasound technique are the common imaging modalities utilized to detect cancer [2]. Microwave cancer imaging provides several substantial benefits that are not offered by other imaging techniques such as it is a fast, safe, low-cost, noninvasive