

Development of a UWB Antenna for Detection of Bone Cancer Using Non-Invasive Microwave Imaging Method

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This paper proposed an ultra-wideband (UWB) antenna designed for the non-invasive detection of bone cancer using microwave imaging techniques. The proposed UWB antenna design features a parasitic loaded octal shape circle slotted patch, FR-4 substrate and a modified ground plane, with optimized dimensions of 23 mm × 30 mm × 1.6 mm. The antenna demonstrates a reflection coefficient of -10 dB, functioning within a frequency range of 2.37 GHz to 13.37 GHz, and achieves a peak gain of 3.94 dBi at 7.5 GHz. The parasitic elements in the patch improve the antenna's realized gain and radiation directionality in free space and in proximity to the Hugo model. The findings demonstrate that the antenna has a fractional bandwidth of 139.77% (2.315–13.37 GHz), a radiation efficiency of 85.75%, a high fidelity factor of 93%, a gain of 3.921 dBi, and adequate field penetration in bone tissue, with a maximum specific absorption rate of 0.0018 W/kg. The performance of the proposed UWB antenna is assessed by importing a Hugo model into the CST MWS to simulate a realistic scenario involving a human body part. This Hugo model includes four distinct types of tissue: skin, fat, muscle, and bone. The tumor tissue is embedded within the bone area, and multistatic modeling is conducted. The scattering parameters are collected, analyzed, and processed using the Iteratively Corrected delay-and-sum algorithm for the detection and reconstruction of bone tumor images. Furthermore, the time-domain features indicate that the antenna could serve as a suitable candidate for microwave imaging of bone cancer.

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