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A Slotted T Shaped Asymmetric Coplanar Waveguide Fed Microstrip Patch Antenna for Microwave Imaging

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In this developmental era, ensuring the good public health and well-being of the population is fundamental to fostering sustainable development, economic stability, and overall quality of life. This importance has led to its inclusion in the Sustainable Development Goals (SDGs). The SDGs are a global call to action aimed at ensuring a more prosperous, peaceful, and sustainable future for all, striving to create an equitable world where no one is left behind [1]. The recent surge in cancer cases has become the primary motivation for this work [2]. This alarming trend underscores the urgent need for advanced research and innovative solutions to improve cancer detection, treatment, and prevention strategies. The potential in Microwave Imaging to be a complementary technology to existing imaging techniques or a standalone technology in the tumor imaging has garnered significant interest from researchers worldwide [3]. In this work, a simple and compact design of microstrip patch antenna with asymmetric coplanar waveguide feeding is presented for healthcare applications using microwave imaging. Microstrip antennas, known for their simple design and cost-effectiveness, often face limitations such as lower gain (typically less than 5 dBi) and suboptimal radiation performance. This work addresses and tries to overcome these challenges, enhancing the gain and improving the overall radiation characteristics to meet the demands of advanced microwave imaging systems. The geometrical layout of the proposed antenna has been developed through some modifications to the radiation patch and feed line. A parasitic ring structure incorporated to the radiation patch improves the gain and directivity value. The proposed antenna is designed on low-profile FR-4 material of thickness1.6 mm and relative permittivity of 4.4. It has been analyzed for different parameters using Ansys HFSS followed by the fabrication of antenna prototype based on the optimal performances obtained from the simulated results. Further, the return loss measurement has been carried out for the fabricated antenna which shows a good comparison with that of the simulated one. The proposed antenna has the significant properties like high gain of about 21 dBi, good directivity of 2.94 dB, compact size with overall dimension of $20 \times 30 \times 1.6\ mm^3$ and wideband characteristics of 2.71 GHz (2.51 to 5.22 GHz) which makes it a suitable candidate for microwave imaging application. Further, a phantom model of breast and head is designed on HFSS platform mimicking the dielectric properties of different layer structure as reported in literatures [4,5]. The presence of tumorous tissues is investigated using the proposed antenna measurement system which acts as transceivers to emit and backscattered electromagnetic signals. The analysis is done on the basis of parameters Transmission Coefficient (S_{12}) and Specific Absorption Rate (SAR) plots for tumorous and non-tumorous phantoms. The results investigated by changing the tumor size and location, also found to be responding with respect to the variations. In conclusion, proposed antenna may be a good candidate for early detection of tumor present in breast and head tissues which may be established as a positive outcome to cure the disease.

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